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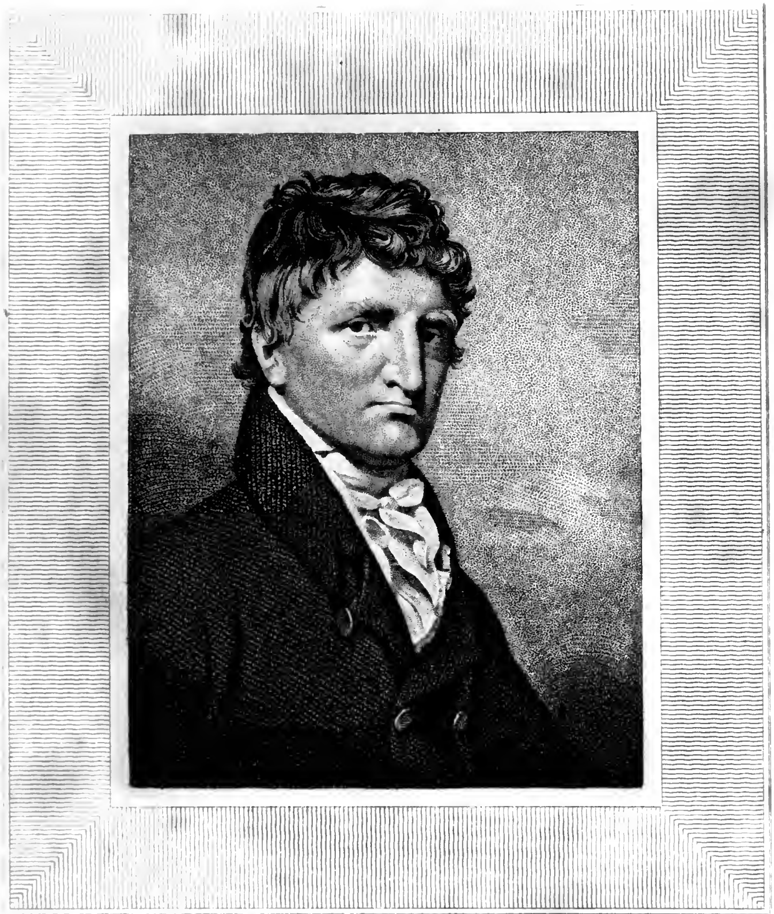

The Right Honourable

SIR JOHN SINCLAIR, BART.

Founder of the Board of Agriculture.

Engraved by W.m Bond from a Miniature painted by A. Robertson Esq.r

...lished Sept... by Sherwood Neely & Jones Paternoster Row

George A. S. Barber

THE

CODE

OF

AGRICULTURE;

INCLUDING

OBSERVATIONS ON GARDENS, ORCHARDS, WOODS AND PLANTATIONS;

WITH

AN ACCOUNT OF ALL THE RECENT IMPROVEMENTS IN THE MANAGEMENT OF ARABLE AND GRASS LANDS.

BY THE RIGHT HONOURABLE

SIR JOHN SINCLAIR, BART.

FOUNDER OF THE BOARD OF AGRICULTURE.

Omnium rerum ex quibus aliquid acquiritur, nihil est Agricultura melius, nihil uberius, nihil dulcius, nihil homine libero dignius.

CICERO de Offic. 1, c. 42.

FIFTH EDITION.

LONDON:

PRINTED FOR SHERWOOD, GILBERT & PIPER,

AND WILLIAM TAIT, EDINBURGH.

INTRODUCTION

AND

PLAN OF THE WORK.

AGRICULTURE, or "*The art of improving and cultivating the Soil,*" had remained for ages in a most imperfect state, and though necessarily practised, in a greater or less degree, by the most enlightened, as well as the most barbarous nations, never, till of late, had made any material progress towards perfection. Those who followed it as their occupation, generally pursued the customs of their forefathers, without inquiring into the circumstances which either led to their adoption, or justified an adherence to them; while such individuals as endeavoured to explain the principles of the art, were rarely acquainted with its minutiæ, and seldom had the advantages of experience. From the great increase of knowledge however, which has of late years been acquired, agriculture has made a most rapid progress in improvement. It is now established on regular and rational principles, and from being an art mechanically practised, it has been elevated to the dignity of *a science;* and hence the era has at last fortunately arrived, when it has become practicable to undertake, with every prospect of success, the arduous task of drawing up "*A Digest,*" or "*Code of Agriculture.*"

Before the present period, such an undertaking could not have been attempted with any well-founded prospect of success. For so many able and well-informed individuals had never, at any former era, directed their attention to agricultural pursuits;—so much capital had never previously been employed in the cultivation of the soil;—so many practical farmers had never before published the result of their experience in the art of husbandry;—so much attention had never been paid to those important branches, the erection of convenient farm-buildings, the improvement of useful instruments of cultivation, or the management of live-stock;—and above all, those minute operations, on the due execution of which, the success of the farmer in a great measure depends, had never been so distinctly pointed out. Hence the superiority of the present era for such an attempt.

If the publication of such a work became advisable, it was peculiarly incumbent on the Author to undertake the task. It was on his suggestion, that the Government of Great Britain established a Board of Agriculture and Internal Improvement, under whose auspices, the greatest exertions were made, to induce the proprietors and occupiers of the soil, not only to make experiments in husbandry, but to communicate their discoveries to the new institution. The agricultural circumstances of every district in the kingdom, were then separately and distinctly examined. A multitude of county reports, drawn up according to one uniform plan, by men of talent and experience, were published *; and various other works, on specific subjects connected with agriculture, were likewise printed under the direction of the Board.

But to enable any person to undertake such a task as the present, it was not alone sufficient that he had access to books, however numerous, or however valuable the information they might contain. It was necessary for him to associate with practical farmers;—to discuss with them the various subjects connected with agriculture;—to survey their farms;—to witness, on the spot, their most important operations;—to examine also the

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TO

THE FIFTH EDITION.

THE Author has now the satisfaction of presenting to the Public, another edition of "*The Code of Agriculture*;" accompanied by accounts of such discoveries as have been made in the art of cultivation, since the preceding impression was published.

It was justly observed by Xenophon, "That in a highly "polished community, the generality of persons should in "some degree be acquainted, with so common a subject of "discussion as that of husbandry." The attainment of that object, it is hoped, will be greatly facilitated, by the publication of a Work like the present, which contains *a general view* of the principles of the art, and an account of its *most approved modes of practice.* By the diffusion of knowledge regarding these important particulars, the prejudices which some unfortunately entertain, either against the superior importance of Agriculture, or the practicability of its further improvement, will be effectually removed.

It is also hoped that this Work, in its present amended state, will prove, beyond the possibility of doubt, the great advantages attending the plan of *collecting and arranging, in one Volume, the general principles of any particular branch of literature or science.* In this manner, not only may a comprehensive view of the subject to be illustrated be obtained, without the labour of consulting numerous publications, but the work may afterwards be reprinted, *with corrections*, at a moderate expense, when any additional knowledge of important facts is acquired. The diffusion of useful information, will thus be rapidly and essentially promoted.

In addition to a Code of Agriculture, it would be highly desirable, to have a separate Work "*On the Minutiæ of* "*Farming;*" which the Author thinks might be condensed within the limits of a volume of similar size. How the execution of such a plan is to be effected, requires much consideration; and it seems, on the whole, to be better adapted, for the exertions of a respectable Society, than for those of a single individual. A particular branch of the subject, under its authority, might be allotted to one person, the most likely to be acquainted *with its details;* and his performance should be circulated, *in a printed form*, for the purpose of collecting the result of the observations and experience of all the most intelligent Practical Farmers in the country.—A Work would thus be obtained, by means of which many *useful modes of practice* would be generally disseminated, and many *errors in husbandry* would be pointed out. The trifling expense which such a plan might occasion, would be most amply compensated, by the permanent advantages that would be derived from it.

JOHN SINCLAIR.

133 *George Street, Edinburgh.*
1831.

INTRODUCTION

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practices of other countries, and to compare them with those at home;—and, above all, to be himself a farmer, and that on a great scale. These requisites have not been wanting on the present occasion.

With these aids, the Author was induced to think, that he might venture to draw up "A Code of Agri-"culture," and to hope, that by compressing the substance of the information which had thus been amassed, into a small compass, he might render it generally attainable. The first edition of the work was printed in 1819. Two additional impressions of it have since been published in this country, and one in America. A fifth in English, with considerable additions and improvements, is now submitted to the consideration of the public. In preparing this edition for the press, advantage has been taken, of several observations transmitted in the communications of foreign authors, or contained in the French, German, and Danish translations, by which means, the doctrines contained in the work, are rendered more applicable to the state of foreign countries, and may become more extensively useful.

In drawing up the original edition, the following plan occurred to the Author as the simplest, and the most comprehensive that he could devise; and he has not since found reason for making any alteration in it.

I. To consider those "*Preliminary points*" which a farmer ought to ascertain, before he can with propriety undertake to occupy any considerable extent of land: in particular, the Climate;—Soil;—Subsoil;—Elevation;—Aspect;—Situation;—Tenure, (whether in property or on lease);—Rent;—Assessments on,—and Size of the Farm.

II. To inquire into "*the means which are the most essen-" tial to insure the success of a farmer;*" namely, Capital;—Regular Accounts;—Arrangement of Agricultural Labour;—Farm Servants;—Labourers in Husbandry;—Live Stock;—Implements;—Agricultural Buildings;—Command of Water;—Divisions of fields;—and Farm Roads.

III. To point out "*the various modes of improving land;*"

by cultivating Wastes;—Inclosing;—Draining;—Manuring;—Paring and Burning;—Fallowing;—Weeding;—Irrigating;—Flooding;—Warping,—and Embanking land.

IV. To explain "*the various modes of occupying land*;"—in Arable Culture;—Grass, (including the Dairy Husbandry);—Gardens and Orchards;—Woods and Plantations. And,

V. To offer some General Remarks, on "*the means of improving a country*;" by diffusing Information;—by removing Obstacles to Improvement;—and, by positive Encouragement.

In the body of the work, general principles are chiefly dwelt upon. Where minute information is necessary, it will be inserted in notes; and some points, which require to be more fully detailed, will be considered in separate papers in an Appendix.

It is only necessary to add, that in drawing up this summary of agricultural knowledge, the Author, having utility, rather than any claim to originality in view, has availed himself of useful information, wherever it was to be found, in writings of acknowledged merit and authority; and he has not hesitated to adopt the language and modes of expression he found in them, where they were distinguished for clearness or precision. In composing the work also, he has endeavoured to adopt a style so plain and familiar, that he trusts it will be easily understood by even the humblest cultivator.—On questions where a diversity of opinion prevails, he has given the substance of the arguments urged on both sides of the subjects under discussion, that the reader may be enabled to judge, which ought to be preferred.

THE

CODE OF AGRICULTURE.

CHAP. I.

PARTICULARS TO BE CONSIDERED, BEFORE A FARMER CAN UNDERTAKE, WITH PRUDENCE, THE OCCUPATION OF ANY EXTENT OF LAND.

THOUGH agriculture is capable of being reduced to simple principles, yet, on the whole, it requires, a greater variety of knowledge, than perhaps any other art ([1]). In addition to the information and extensive experience which must be acquired by a farmer, to enable him to cultivate the soil with success, or to manage his stock with profit, it is necessary for him, before he can undertake with prudence, the occupation of any extent of land, deliberately to consider the following important particulars: The climate;—The soil;—The subsoil;—The elevation;—The aspect;—The situation;—The size;—The tenure;—The rent;—and the other burdens affecting the farm. These preliminary points, it is here proposed briefly to illustrate.

SECT. I.—*Climate.*

BY the term *Climate*, is meant in popular language, the nature of the weather,—the temperature,—and the atmospherical phenomena, peculiar to any particular district or country.

It is much to be regretted, that sufficient attention is rarely paid by the farmer, to the peculiarities of the climate in which his operations are carried on. Unless the plan he follows, be adapted to the weather which his crops are likely to experience, every exertion will often terminate in disappointment. The system that is proper for dry and warm situations, is not suitable for those that are cold and wet; and in a cold and backward climate, not only ought the nature of the soil to be attended to, but the utmost care should be paid, to the early sowing of the earliest varieties of seed. Even the species of stock to be bred or kept on a farm, should in a great measure be regulated by the climate. Hence, this is a subject, which the diligent farmer will invariably study with the greatest solicitude (2).

In considering the climate of a country, the following points are of peculiar importance: Its general character, and the means of its improvement;—The degree of local heat;—The amount of light;—The quantity of moisture;—The prevailing winds;—The position of the place, whether maritime or inland;—The regularity of the seasons;—The more remarkable natural phenomena in the country;—The productions best suited to the climate;—The expenses it may occasion in cultivation;—The introduction of exotic plants, and animals from other climates; and—The means of ascertaining the real nature of a climate, since registering its variations, in the different seasons of the year, would be attended with much advantage.

1. *General Character.*—This not only depends on the position, or latitude, but likewise on the elevation of a country above the level of the sea;—its general aspect;—the vicinity of mountains, forests, bogs, marshes, lakes and seas;—the nature of the soil and subsoil, and the power which the former possesses of retaining heat and moisture;—the direction of the winds;—the length of time the sun continues above the horizon;—the difference of temperature between the day and the night;—and the extent of dry earth in the neighbourhood. The result of these particulars combined, forms, what may be called, "The general character of a climate."

Some of the causes of an unfavourable climate cannot be remedied by any human effort; but in many cases, it may be improved by various modes, and by the following in particular:

A district covered with wood is moister, and has a greater range of the thermometer between the extremes of heat and cold, than a country cleared of woods, though in the same latitude. Thick woods exclude the rays of the sun, and prevent the ground from being dried by evaporation. Hence the summers, (at least during a part of the day), are warmer, but the winters are colder. By cutting down a great part of these woods, and leaving only what is necessary for shelter, a more equal temperature may be obtained.

An immense accumulation of cold, inert, and spongy peat earth, in bogs or mosses, produces exhalations, which chill the atmosphere, greatly injure the vegetables over which they extend, and increase the bleakness of the climate in their respective neighbourhoods. They likewise occasion great humidity in the atmosphere, and too frequent falls of rain. By drainage and cultivation, these pernicious effects, are either wholly removed, or greatly mitigated.

In bleak and comparatively barren situations, it is highly beneficial to divide the land into small inclosures, with hedges and belts of planting, for the sake of warmth and shelter ([3]); and were even a part of the heights of a country planted with judgment, the force of the wind would be diminished, its action divided, and the climate materially softened ([4]); the benefit of which would be felt, not only on the hills, but also, from the shelter and additional warmth which would thus be given, on the plains below.

In low and flat situations, on the other hand, every obstruction to a free circulation of the air should be removed, by enlarging inclosures, thinning and clipping hedges, and judiciously pruning hedge-row trees. Particular attention ought likewise to be paid, to the important operations of draining the soil. By these means, the climate may be rendered more salubrious, and the fruitfulness of the earth, augmented to a degree, not otherwise to be expected ([5]). And, lastly,

The climate of an extensive region may be much improved, by cutting down large forests, by draining great lakes, by laying dry extensive marshes, and above all, by judicious cultivation. When the surface is broken, water subsides into the soil, instead of either resting on it, or being thrown off in torrents, which are often the source of much mischief; and if the surface is formed into ridges and furrows, the soil is not only enabled to imbibe the salutary rays of the sun, but the drainage of the land, from superfluous water, is greatly facilitated ([6]). These processes, therefore, have the effect of regulating moisture, diminishing cold, and accumulating heat ([7]). The instances which history furnishes of such improvements, conducted on an extensive scale, and attended by these advantages, are numerous, and well authenticated; and thence many countries now possess a genial climate, which in former times were scarcely habitable for cold ([8]).

2. *Heat.*—The importance of heat, as a stimulus to vegetation ([9]), cannot be doubted. It is at a certain degree of heat that vegetation commences, and it becomes nearly stationary, when the temperature falls below it. There are, comparatively speaking, but few plants calculated for very cold countries, and these are seldom valuable; whereas in warm

and even temperate regions, the variety is great, and their value unquestionable. Indeed such is the effect of cold, that while the thermometer is below 40°, the strongest plants become torpid, and remain in that state so long as this low degree of temperature continues ([10]). Revived by the warmth of spring, and strengthened by the heat of summer, they acquire fresh life and vigour, and are thus better enabled to withstand the rigours of the succeeding winter.

Heat is essential for bringing every plant, fruit, or species of grain, to perfection. Hence, an increased temperature, when not carried to excess, will augment the quantity of nutritive matter in a plant, or improve the quality of fruit grown under its influence. Thus English barley, *of equal weight*, is more valuable than Scotch barley, because, from growing in a warmer climate, and enjoying the advantage of a greater quantity of light, it is more fully ripened. It thence acquires more saccharine matter, and produces a greater quantity of spirits, or of malt liquor ([11]).

It is also proved, by the experiments of Sir Humphry Davy, that wheat ripened in a more regular and warmer climate, contains more of that valuable substance called gluten, than the same species of grain, when raised in England.

The medium, or average heat of the year, is not, however, of so much importance to the growth of plants, as its duration, and its continuing steady at a certain degree, during the season when the grain is ripening. This gives the uniform climates of the Continent, a great advantage over our variable seasons, in the production of the more delicate sorts of fruit; which, in this island, are often injured by the frosts in spring, and seldom ripen perfectly in a climate, where the greatest summer heat is both unsteady, and of short duration ([12]).

3. *Light.*—The quantity of solar light which a climate furnishes, is likewise an important object of inquiry. It is ascertained that roots, not having the advantage of light, are not so wholesome an article of food, as the various species of grain. Plants will grow in the dark, as in mines or cellars; but in such situations, the colour of their leaves is not vivid, and their seed is not brought to perfection. They have such an affinity to light, that if put into a dark place, they will always bend to any hole or window where it is admitted ([13]). Light is essentially necessary for increasing the proportion of starch or farina;—completing the formation of oils in plants; —and giving to fruits their proper colour, and flavour. It has also the effect of augmenting saccharine matter, insomuch that those sugar-canes which are exposed to the sun, have more

of that important ingredient, than when they grow under a shade.

Nor ought the observation to be omitted, that darkness and light have effects directly opposite upon vegetables. Darkness favours the elongation of plants, by keeping up the pliancy of their parts; light consolidates them, and stops that elongation, by favouring nutrition. Hence, in the northernmost regions, where plants go through all their stages of growth, at a time, when the sun no longer quits the horizon, the light of which they thus experience the unremitting effect, hardens them, before they have time to lengthen. Their growth is there quick, but of short duration. They are robust, but undersized ([14]).

4. *Moisture.*—The importance of moisture to vegetation cannot be questioned. Water constitutes a large proportion of every plant, and is the vehicle by which nutriment, in a state of solution, is conveyed to plants. Hence, without so essential an ingredient, they must either become stunted in their growth, or perish. In dry weather, when vegetation seems at a stand, no sooner do showers of rain fall, than a rapid growth, of every kind of herbage, or of corn, immediately succeeds. This takes place even on poor dry soils, where otherwise, however well manured, vegetation would make but slow progress ([15]).

The quantity of rain that falls annually in any country, is a very inferior consideration, when compared with that of the *general and equable distribution* of that quantity, throughout the several days and months of the year. A great abundance, falling at the same time, is rather hurtful than beneficial; whereas those moderate, but *golden showers*, which regularly fall on a soil prepared to receive them, are real sources of fertility. It is by this that the character of a climate, whether wet or dry, is chiefly determined, and the operations of agriculture are principally influenced ([16]).

The utility of moisture, with a view to vegetation, depends much on the quality of the soil. The heavy rains which prevail in the western districts of this Island, (varying from 40 to 60 inches in the course of a year), are in general favourable to crops growing on sandy, gravelly, or very dry land, but are injurious to the same crops, if produced on clayey or heavy soils. To bring grain crops to perfection, a certain portion of moisture is necessary, but weather moderately dry, is most favourable to an abundant produce, more especially of wheat, which is peculiarly liable, when in blossom, to be injured by rain. An excess of moisture is prejudicial at any season of the year, but more especially in seed-time and harvest. In regard to the former, if the seed does not get a dry bed, the crop it produces is necessarily much injured; and the more completely that the damps of winter and spring are dried up, in the months of March, April, and May, the greater is the chance of an abundant return at harvest.

The disadvantages of a wet climate to a farmer, more especially if accompanied with a retentive soil, are very great. It is calculated, that in the richest district in Scotland, the Carse of Gowrie, there are only about twenty weeks in the year fit for ploughing; whereas in several parts of England, they have thirty weeks, and in many cases more, during which this essential operation can be performed. Hence ploughing must be much more expensive in the one case than in the other.

The season of the year in which rain abounds, is likewise of much importance. An excess is prejudicial in any season, but is peculiarly so in autumn, when it often lodges the grain by its violence, or, by its long continuance, prevents the corn from being properly harvested. The hopes of the husbandman are thus blasted, and the fruits of his toil and industry are frequently diminished, and sometimes entirely lost ([17]).

Dews also, have a great effect in furnishing plants with moisture; and, indeed, without their aid, vegetation, in warm and dry climates, could not go on. Even in temperate regions, dews are beneficial. In Guernsey, on the coast of Normandy, the autumnal dews are singularly heavy, so much so, that in the middle of a hot day, the dew drops are not quite exhaled from the grass. From this moisture, the after-grass receives great benefit ([18]). Dr Hales estimated the quantity of dew that falls in one year, at three and a half inches: Mr Dalton at nearly five inches. In this matter, however, it is not easy to be correct. It must vary indeed in different places, and even in the same place in different seasons.

5. *Prevailing Winds.*—These have a great influence on the character of a climate, and powerful effects on vegetation. When they pass over a large expanse of water, they are usually of a warmer or higher temperature in winter, than those which blow over high lands; more especially if such come from countries covered with snow. Hence the east and north-east winds, which have passed over the coldest regions of Europe, are much colder than the west and south-west winds, which blow over the Atlantic Ocean, and they oftener occasion blights. The former are comparatively drier, unless when

accompanied by those thick mists, called *haars*, arising from the copious evaporation of the German Ocean [19]. The latter are loaded with the vapours of the Atlantic, and are often rendered prejudicial by excess of moisture. The strength of the prevailing winds, or the violence with which they act, more especially during harvest, ought likewise to be considered [20]. If they are very violent, they are apt to affect the crops; and of course it becomes an object, to suit the produce to them, and to form fences, inclosures, and plantations accordingly.

6. *Position, whether Maritime or Inland.*—A maritime position, occasions a more equal temperature in a climate. Where a great body of land is exposed to the rays of the summer sun, the air becomes much warmer than it would if resting upon a small body of land, contiguous to, or surrounded by the ocean. On the other hand, as the sea always preserves nearly the same temperature, and, except in the most northern regions, is never frozen, it communicates warmth, in the cold seasons of the year, to the air passing over it, which had been cooled in its passage over continents covered with ice and snow [21]. Hence islands are more temperate than continents. It appears indeed, that the thermometer has not so great a range on the sea-coast, as in the more inland parts of Great Britain, even at an elevation of 400 feet above the level of the sea [22]. Of the influence of proximity to the sea, many proofs might be brought forward. It is in consequence of this circumstance, that the city of Moscow, which is situated farther south than Edinburgh, experiences winters much more severe.

Another effect of a maritime position is, that strong winds which blow from the sea, are sometimes accompanied by salt spray, or vapour, which is injurious both to crops of grain, and the leaves of trees [23]. When it comes in moderation however, those saline particles, with which the westerly winds are loaded, contribute to promote the verdure of the fields in pasture [24].

The nature of *the inland position* is also of much importance. The relative position of the neighbouring hills, occasions a material difference of climate, exposing some districts to great severity of weather, and by protecting others, greatly promoting their fertility.

7. *Regularity of the Seasons.*—In many countries the seasons are regular. In others, as in Great Britain, they are extremely variable, and often change, in the space of a few hours, from dry to moist, from hot to cold, from clear to

cloudy, and from pleasant serenity, to all the violence of a tempest ([25].) Some have argued, that such irregularity of climate is not unfavourable to health, as the inconstancy of the atmosphere tends to refine and purify the air, and render it more salubrious. But whatever truth there may be in that observation, every farmer knows, that the unsteadiness and irregularity of our climate, more especially on the western side of the island, are extremely injurious to husbandry, and form one of the greatest local evils that farmers have to lament.

8. *More remarkable Natural Phenomena.*—The climate of a country is likewise affected by earthquakes;—volcanos;—violent thunder storms;—lightning;—hail-storms in summer;—early frosts ([26]);—whirlwinds and hurricanes;—water-spouts;—and by that atmospheric appearance, known under the name of the *aurora borealis*, so frequently to be seen in northern, and sometimes even in southern regions; but these phenomena are for the most part only occasional, sometimes prevent greater calamities ([27]), and in this country, are rarely attended with permanent evils.

9. *Effects of Climate on Productions.*—The size, and, in many cases, the value of the productions of a country, depend upon its climate, by whose influence their growth may either be advanced or retarded. The same species of tree which, in a temperate climate, will rise to a great height, and swell to an immense size,—in an exposed situation will remain small and stunted. By a favourable climate also, the most barren spots, which in a cold country must remain completely waste, in a warm one may be rendered productive. Thus, where the climate is adapted to the culture of the vine,—rocks, which in Great Britain, and in colder countries, would in general be of little or no worth, in the southern provinces of France may be made to yield as much in valuable produce, as the cultivated land in their neighbourhood ([28].) The real excellence of a climate, however, depends on its producing, in perfection and abundance, the necessaries of life, or those which constitute the principal articles of food for man, and for the domestic animals kept for his use. In this point of view, a meadow is much more productive, and in some respects more valuable, than either a vineyard or a grove of oranges; though the one may be situated in a cold and variable climate, and the other in a country celebrated for the regularity and the elevation of its temperature ([29]).

The very nature of the articles raised, depends upon the climate. Thus, in many elevated parts both of England and Scotland, wheat cannot be grown to advantage, and in some of the low-lying districts of the latter, the cultivation of that important plant has never been attempted ([30]). In several of the northern counties of North Britain, it has been found necessary to sow, instead of the two-rowed barley, the inferior sort called bear, or big ; and oats, from the hardy quality of the grain, are found to be a more certain and more profitable species of corn than any other ([31]), while in humid districts, pease or beans cannot be safely cultivated, from the periodical wetness of autumn. On the whole, without great attention to the nature of the climate, no profitable system can be laid down by any occupier of land ([32]). Indeed, as plants are fixed to one spot, are constantly exposed to the open air, derive a portion of nourishment from the atmosphere, and can neither move nor defend themselves from its influence, they are more affected by climate than even the human race.

10. *Effects of Climate on the Expense of Cultivation.*—An inferior climate, is highly prejudicial to the farmer in another respect : it materially augments the expenses of cultivation, because a greater number of horses are required for labour, during the short period of the year when the weather will admit of it, while, at other seasons, they are a useless burden upon the farm. When to this are joined, an uneven surface, and an inferior quality of soil, arable land is of little value, and yields but a trifling rent ([33]).

11. *Introduction of Exotic Plants and Animals.*—It has been remarked, that many circumstances frequently occur, which render a greater knowledge of climate necessary, than usually falls to the share of the generality of husbandmen, even of the higher order ; and this observation is peculiarly applicable, when plants, not indigenous in a country, or new breeds of animals, are introduced into it ([34]). Daily experience proves, that many of the vegetable and animal productions of one country, may be naturalized in another ; but that this can only be done successfully, by paying attention to the climate whence they were brought, and by endeavouring, either to render that to which they are introduced, as similar to it as circumstances will admit of, or to counteract, by judicious management, the deficiencies of the new one.

12. *On the Means of ascertaining the Nature of a Climate.*—In this respect the farmer, in modern times, has many advantages which his predecessors wished for in vain. The progress of science has given rise to the invention of many new instruments, by which the real state of natural phenomena is ascertained, with a considerable degree of accuracy, instead of conjectures or systems being founded on loose or general

experience. It may still be proper to study the appearance of the heavens, and not to despise old proverbs, which often contain much local truth ([35]); but the *vane* now points out the quarter whence the winds blow, with all their variations;—*the barometer* ([36]) often enables us to foretell the state of the weather that we have reason to expect;—*the thermometer* ascertains the degree of heat;—*the hygrometer* ([37]), the degree of moisture;—and *the rain-guage*, the quantity of rain that has fallen during any given period. By keeping exact registers of all these particulars, much useful information may be obtained.

The influence of different degrees of temperature and humidity, occurring at different times, may likewise be observed, by comparing the leafing, flowering, and after-progress of the most common sorts of trees and plants, in different seasons, with the period when the several crops of grain are sown and reaped each year ([38]).

The farmer who thus attends to the character, the progress, and the length of the seasons ([39]), and registers them with accuracy, elevates himself above the station of an ordinary cultivator, and the facts which it is thus in his power to furnish, may essentially promote "*The Science of Agriculture.*"

Sect. II.—*Soil.*

The surface, or outer coating of land, usually consists of a collection of various earthy matters, in a loose and porous state, with a mixture of animal and vegetable substances, partially decomposed, together with certain saline and mineral ingredients. Where favourably combined, it is admirably calculated to afford support to plants, to enable them to fix their roots, and gradually to derive nourishment by their tubes, from the soluble and dissolved substances contained in the *soil*, as this mixed mass is called ([40]). The strata on which it rests, are known under the general name of *subsoil.*

The importance of the soil has been described in various ways. By some it has been called the mother, or nurse of vegetation ([41]). By others it is represented as discharging functions to plants, similar to those which the stomach does to animals, in preparing their food, and fitting it for absorption by their roots. It furnishes the plant also with heat; for a well-cultivated and highly manured soil, is much warmer than the surrounding atmosphere ([42]). The farmer, it is said, ought to study the relative value of the different soils, as a merchant does the worth of the several commodities in which he deals ([43]). Good soils, it has been justly remarked, seldom yield a scanty produce; whereas poor soils are with difficulty rendered productive. In short, a favourable soil and climate, are deservedly accounted, "*The first* "*riches of a country* ([44])."

The necessity of paying attention to the nature and quality of the soil, need not therefore be dwelt upon. By ascertaining its general properties, improving its good qualities, and obviating its defects, the profits of a farmer may be greatly increased. He must, in general, regulate his measures accordingly, in regard to the rent he is to offer,—the capital he is to lay out,—the stock he is to keep,—the crops he is to raise,—and the improvements he is to execute. Indeed, such is the importance of this subject, that no general system of cultivation can be laid down, unless all the circumstances regarding the nature, and situation of the soil and subsoil, be known ([45]); and such is the force of habit in the management of land, that if a farmer has been long accustomed to one species of soil, he will seldom be equally successful in the treatment of another ([46]).

From inattention to the nature of soils, manures have often been improperly applied, and many foolish, fruitless, and expensive attempts have been made, to introduce different kinds of plants, not at all suited to them. This ignorance has likewise prevented many from employing the means of improvement, in cases where the expense would have been trifling. From ignorance also, of the means calculated for the proper cultivation of the different soils, many unsuccessful, and even pernicious practices have been adopted.

It may be proper to add, that a variety of soils, which at first sight seems to be a defect, is in reality a remarkable proof of the goodness and wisdom of Providence; for there is hardly any soil so ungrateful, as not to reward the labours of the husbandman, if he will only bestow proper care on its culture; and as each soil has particular articles, for the growth of which it is peculiarly calculated, a greater variety of useful substances are thus obtained ([47]).

To devise an arrangement of soils, at once comprehensive and distinct, is no easy task. The distinctions ought to be simple and obvious, without regard to minute differences, which are of no material importance. On the whole, it would appear, that soils may be advantageously classed, *for practical purposes*, under the following general heads: Sand,—Gravel,—Clay,—Chalk,—Peat,—Alluvial Soil,—Marsh Land, —and Loam, or that species of artificial soil, into which the others are generally brought, by the effects of manure, and of earthy applications, in the course of long cultivation (48).

While describing each sort, we shall briefly state the modes of improving their texture;—the crops for which they are respectively calculated;—and the districts where they are cultivated with the greatest success.

1. *Sand.*—A soil that consists entirely of small grains of a siliceous nature, which neither cohere, nor are softened by water, nor soluble in acids, though it ought not to be totally abandoned (49), yet is too poor to be cropped with advantage. The cultivation of such a soil would indeed be hazardous in the extreme, from the risk of having it blown off the new-sown grain, in the spring, by high winds (50). Sandy soils, however, generally have a considerable mixture of other substances, by which their quality is greatly ameliorated.

The best mode of improving the texture of such a soil, deficient in retentive or adhesive properties, is, by a mixture of clay, marle, warp (the sediment of navigable rivers), sea-ooze, sea-shells, peat, or vegetable earth; and it frequently happens, that under the sand itself, or in its immediate neighbourhood, the materials may be found which are requisite for its improvement (51). Even light sandy soils, are thus rendered retentive of moisture and manure; and, when judiciously treated, are considered to be more profitable, than the wheat and bean lands in their neighbourhood (52).

In some parts of Norfolk, the farmers have availed themselves of these auxiliaries, for improving a sandy soil, in an eminent degree. They have thus entirely changed the nature of the soil; and by the continuation of judicious management, have given a degree of fame to the husbandry of that district, far surpassing that of others naturally more fertile (53).

The improvement of a sandy soil, is generally accomplished by fossil manures; but vegetable substances are likewise of great service. A top-dressing of peat has been tried for that purpose, and the experiment was attended, not only with immediate good effects, but with permanent benefit (54).

Though sandy soils are not naturally valuable, yet being easily cultivated, and well calculated for sheep, that most profitable species of stock, they are often farmed with advantage. Where the land is hilly, rabbits are frequently kept, for that animal can easily throw down the light soil, from the hole he excavates, where there is a declivity. Hence it has been remarked by some, that *loose-soiled hills*, will pay better in rabbit-warrens, than under any other mode of occupation ([55]). Others maintain, that planting is a more profitable appropriation of such hills; but this is considered to be erroneous, as shall be afterwards explained in the Section on Plantations. (Chap. IV. Sect. 4).

Sandy soils, however, of a good quality, under a regular course of husbandry, are of great value. They are easily worked, and at all seasons; they are cultivated at a moderate expense; are not so liable to injury from the vicissitudes of the weather; and in general are sufficiently retentive of moisture, to produce good crops even in dry summers ([56]).

The crops raised on sandy soils are numerous, such as common turnips, — potatoes, — carrots, — barley,—rye,—buck-wheat,—pease,—clover,—sainfoin, and other grasses. This species of soil, in general, has not strength enough for the production of Swedish turnip, beans, wheat, oats, flax, or hemp, in any degree of perfection, without much improvement in its texture, the addition of great quantities of enriching manure, and the most skilful management ([57]).

It is of great advantage to sandy soils, when under a course of cultivation, either to fold sheep upon them, or to consume the crops of turnips upon the ground where they are raised. These practices, greatly contribute to the improvement of such soils; which are thence enabled to produce luxuriant crops of corn, not only by the dung and urine thus deposited, but by the consolidation and firmness of texture which the treading of the sheep occasions. When they are cultivated, manure should be frequently applied, and the vegetable matter should be less decomposed or rotted, than on other soils. Some farmers, likewise, insert the putrescent manure they employ, at a considerable depth, (8, 10, or 12 inches), to prevent a too rapid decomposition.

The carrot husbandry, in the "Sandlings" of Suffolk, as they are called, is one of the most interesting objects to be met with in British agriculture. After all expenses are defrayed the profit is considerable; and the carrots are found to be an admirable preparation for other crops ([58]). Some prefer fattening bullocks with them; while others, who have the advantage of water-carriage, think it most beneficial to send them to the London market.

In Norfolk and Suffolk it is found that sandy soils, with a subsoil of chalk, or other calcareous substance near the surface, so poor, as not to be worth 5s. per acre for any other purpose, if laid down with sainfoin, will produce, for several years, about two tons per acre of excellent hay, and an aftergrass extremely valuable for weaning and keeping lambs. How much more valuable, than any crops of grain that such soils usually yield (59).

The management of sandy land, according to the system adopted by the celebrated Duckett of Petersham and Esher in Surrey, has been strongly recommended by an eminent author. It was founded on three principles: 1. Ploughing very deep, by which a due degree of moisture was preserved in his light land, and the crops were flourishing in seasons of drought, which destroyed those where the ploughing had been shallow;—2. Ploughing seldom, but effectually, by a trench plough, or what he called a skim-coulter plough, with which he buried the weeds that grew on the surface: he has thus been enabled, to put in seven crops with only four ploughings; and,—3. Occasionally he has raised a crop of turnips in the same season, after a crop of wheat, or of pulse (60).

In the Pays de Waes in Flanders, sand is likewise cultivated to great perfection. The soil of that district, which was originally a barren white sand, by a slow, but sure process, has at last been converted into a most fertile loam. The surface alone, to the depth of three or four inches, was at first cultivated, and it was enriched with a considerable quantity of manure, but the soil was gradually deepened, as it became progressively more fertile; and now the ground, at the commencement of every rotation, is trenched by a *shovel*, (the soil being very loose), to the depth of from fifteen to eighteen inches, the exhausted surface is buried, and fresh earth brought up, fertilised by the manure washed down to it, during the seven preceding years. It is then subjected to the following course of crops: 1. Potatoes; 2. Wheat, manured, sown in November, among which the seed of carrots is sown in February, for a crop in the same year; 3. Flax, manured, and sown with clover-seed, for the next crop; 4. Clover; 5. Rye or wheat, with carrots for a second crop; 6. Oats after the carrots; and, 7. Buck-wheat; at the end of which period the ground is again trenched (61).

The double crops raised in the sandy soils of Flanders, in the course of the same year, are attended with much advantage. The Flemish farmers, thereby obtain a greater quantity of manure, than they could produce under any other system, and thus are enabled to extract so much produce from soils, which were originally sterile, and which would soon revert to their former state of barrenness, without the greatest industry, and the most unwearied attention (62).

In the management of sandy soils, three rules are to be observed: 1. Never to pick off any small stones that may be found in them, as they answer many valuable purposes: they shelter the young plant in bad weather; they preserve moisture, and prevent the crops from being burnt up by scorching heats; they hinder the evaporation of the enriching juices; and, by these means, greatly assist the progress of vegetation (63). 2. Frequently to renovate the strength of such soils, by laying them down with grass-seeds, and pasturing them for a few years, as they are apt to be exhausted by ploughing, if corn crops are too frequently repeated; and, 3. When farm-yard dung is applied to this description of soil, always to give it in a state of compost, with a view of adding to the tenacity of the soil, and of preventing the manure from being dissipated in a dry season, or washed down by rain (64).

It may be added as a general maxim, that the fertility of sandy, or siliceous soils, is in proportion to the quantity of rain that falls, combined with the frequency of its recurrence. As a proof of this, in the rainy climate of Turin, the most prolific soil has from 77 to 80 per cent. of siliceous earth, and from nine to fourteen of calcareous; whereas in the neighbourhood of Paris, where there is much less rain, the silex is only in the proportion of from 26 to 50 per cent., in the most fertile parts (65).

2. *Gravel.*—Gravelly soils differ materially from sandy, both in their texture, and modes of management. They are frequently composed of small friable stones, sometimes of flinty ones; but they often contain granite, limestone, and other rocky substances, partially, but not very minutely decomposed. Gravel, being more porous than even sand, is generally a poor, and what is called, *a hungry soil*, more especially when the parts of which it consists are hard in substance, and rounded in form (66). Gravelly soils are easily exhausted; for the animal and vegetable matters they contain, not being thoroughly incorporated with the earthy constituent parts of the soil, (which are seldom sufficiently abundant for that purpose), are more liable to be decomposed by the action of the atmosphere, and carried off by water (67).

Gravelly soils are improved by draining, if they are troubled with springs, which is sometimes the case;—by ploughing rather deep;—by mixing them with large quantities of clay, chalk, marl, peat, or other earth;—by frequent returns of grass crops;—by repeated applications of manure;—and by irrigation, more especially if the water be full of sediment, and judiciously applied.

Sometimes the ground is so covered with flints and stones, that hardly any mould is to be seen. Land of this description is very troublesome to work, and is injurious to the implements of husbandry employed in the cultivation; but with proper management, it can often be rendered highly productive([68]). The stones on the surface, by sheltering and keeping warm, in the cold seasons, any small quantity of soil which is amongst them, and by protecting it from the scorching influence of the sun, in the hot seasons, frequently produce abundant crops([69]).

The *stone-brash* or *corn-brash* soils, (as they are provincially called) of Gloucestershire, and the midland counties of England, may be included under the general head of *gravelly soils*, being much mixed with small stones. They have frequently, however, more sand, or clay, or calcareous loam, in their composition, than gravelly soils usually possess; and on that account, are treated of by some authors as a distinct species of soil ([70]).

Gravelly soils, from their parting so readily with moisture are apt *to burn*, as it is called, in dry seasons; but in wet ones, they usually produce abundant crops of barley, rye, tares, pease, oats, and even wheat. It has been found, that a thin stratum of gravel, if mixed with shells, and other marine productions, possesses many advantages for cultivation in a wet climate ([71]).

Gravelly soils, free from stagnant water, give such an additional warmth to the climate, that vegetation is nearly a fortnight earlier, than where other soils predominate ([72]). About Dartford and Blackheath, in Kent, they produce early green pease, winter tares, rye, autumnal pease, and occasionally wheat, in great perfection ([73]). When barley and oats are cultivated, they should be sown *very early*, that they may have full possession of the ground before the dry season sets in ([74]). Gravelly soils, in a wet climate, answer well for potatoes; and indeed, in Cornwall, in a sheltered situation, with a command of sea-sand, and of sea-weed, they will produce two crops of potatoes in the same year ([75]).

Poor gravelly soils, full of springs, and those sulphureous, are very unfriendly to vegetation, and are better calculated for the production of wood, than for arable culture ([76]).

3. *Clay.*—A clay soil is distinguished above every other for its tenacity. It is principally composed of particles of earthy matter, many of them so small, that when separated from each other, they are imperceptible to the touch, and will easily float in water; yet these minute particles form a soil, that is far more tenacious and adhesive than any other species of earth. Clay swells considerably when it is wet. It then feels soft and clammy, and adheres much to the plough, or to any thing with which it comes in contact. In that state, it will hold water like a dish. When dry, it contracts in volume, and becomes as hard and tenacious as bricks when prepared for the kiln. In a dry summer, the plough turns it up in great clods, scarcely to be broken or separated by the heaviest roller. It requires, therefore, much labour to reduce it to a state fit for producing either corn or grass ([77]), and it can only be cultivated, when in a particular state, and in favourable weather. Though it will therefore, under a proper system of management, yield great crops, yet being cultivated at a heavy expense, requiring stronger instruments, and stouter horses, it is seldom that much profit is obtained, unless when occupied by an attentive and industrious farmer.

The value of clay, and of every other soil, depends much on the quality of the substances on which it rests, for an open subsoil renders it more tractable and productive ([78]). Indeed, a subsoil of sand or gravel, under the clay, and near to the surface, is of all others the most desirable. But such a favourable formation of soil and subsoil is rarely to be met with. Clay, resting on whin rock, being more mixed with earthy substances, is always more friable, and more productive, than when it is incumbent on freestone, or coal metals. But by far the greatest proportion of this species of soil in Scotland, rests on a coarse species of clay, of a hard and obdurate nature, mixed with ferruginous matters, and known under the name of *till.* It is commonly of a considerable depth, and so close and adhesive, that no water will sink through it.

In improving a clay soil, it is of much importance, to ameliorate its texture, by a suitable mixture of common sand, sea-sand, and above all, of limestone gravel, where that can be obtained. Peat-moss also, that has for some time been dug up, and exposed to the action of the atmosphere, may be used with advantage. It is likewise necessary, in the course of its cultivation, to enrich it with putrid and calcareous manures; and it may be much improved by having a considerable quantity of ashes mixed with its putrescent manures. It is this which renders clayey soils, in the neighbourhood of towns, so extremely fertile. Burning part of the clay, to be afterwards incorporated with the soil, to render it more friable, has likewise been attended, in some instances, with advantage, more especially if there is any marle in its composition.

Clay soils require much labour and expense to render them productive; but, under proper culture, they are well calculated for growing crops of beans, wheat, oats, clover, and winter tares. They are not, however, adapted for barley, unless immediately after a fallow; nor for potatoes, unless under very peculiar management ([79]). Turnips do not usually thrive so well in clays, as in soils which are more free and open. But it is now ascertained, that the Swedish ([80]), and above all, the yellow turnip, may be raised in them with advantage;—that the quality is superior;—that if they are taken up early, the soil is not injured;—and that there is no difficulty in preserving them. Clays become good meadow lands, and answer well for hay, or soiling, when in grass; but from their aptitude to be poached, they are, in general, unfit to be fed by heavy cattle in wet weather. In dry seasons the after-grass may be used to feed young or lean cattle till October, and sheep till March ([81]). A stiff clay also, when not cold or wet, with a strong marle under it, is preferred in Cheshire and Derbyshire, for the dairy ([82]); and in Ayrshire, with a less favourable subsoil, cows are pastured in clay soils with profit.

Ploughing previous to winter setting in, is of great use to clays, by exposing the surface to the frost, which mellows and reduces it in a manner infinitely superior to what could be accomplished by all the operations of man. In this state, the soil may remain till spring-seed time, when it ought to be either ploughed with a shallow furrow, or merely scarified, (which is the superior practice), and sown ([83]).

The fallowing of strong clay, (a subject to be afterwards more fully discussed), is by some eminent farmers deemed to be unnecessary, provided particular attention be paid to the bean crop, and to sowing early, horse-hoeing regularly, and weeding completely. Yet there are certainly many clay soils, both in England and Scotland, so tenacious and obdurate, so adhesive to every thing that comes in contact with them when wet, and assuming, when dry, such a stony hardness, that they are but ill calculated, in that stubborn state, for the purposes of vegetation ([84]). With such soils, a summer-fallow is indispensably necessary every six, or at farthest, every eight years, both to prevent their contracting a most injurious sourness and adhesion from ploughing in wet weather, and in order that, by exposure to the sun and winds, during the summer months, they may be thoroughly pulverized, and aërated. By cultivation, joined to the corrective influence of the atmosphere ([85]), they may thus be brought into a state fit for bearing abundant crops of grain and grass ([86]).

4. *Peat.*—This substance is unquestionably of vegetable origin. The difference between it and vegetable mould is this, that mould is derived from finer substances, as the leaves of trees,—the remains of arable cultivation,—and the roots, as well as the leaves and stalks of the finer grasses, which contain a large proportion of earthy matters; whereas peat is chiefly composed of various sorts of aquatic plants, hard grasses and heaths, which, instead of rotting on, or near the surface, are generally immersed in stagnant water, and only partially decomposed. In valleys, peat-moss has often a considerable proportion of vegetable earth washed from the higher grounds.

The classification of mossy or peaty-soils, has been treated of by various authors, who have written on that subject, but scarcely any two of them have concurred in opinion. Some have arranged moss, by the diversity of its colour,—some by its density,—some by its specific gravity,—and some by the materials of which it is composed. An author, who has successfully explained the nature of peat, (Mr Aiton), rejects all distinctions, except those which relate to moss in an agricultural point of view. He terms the thin black mould, on dry moor-ground, "*hill-moss*;"—that which is from six inches to two feet in depth, and covered with a close sward of green herbage, he terms "*bent-moss*;"—and the deeper mosses, that have little herbage but heather, (*Calluna* and *Erica*), and moss fogs, as *Sphagnum palustre*, *Hypna*, &c. he denominates "*flow-moss*."

In converting peat into earth, it is a rule, more especially for the first time, to plough or dig it in autumn, that it may be effectually exposed to the winter's frost. If this foundation of its future improvement be not commenced at a proper season of the year, and if the peat be once hardened by the summer's sun, it is hardly possible afterwards to decompose it ([87]).

The crops best calculated for a reclaimed peat-bog or moss, are, oats, rye, beans, potatoes, turnips, carrots, coleseed, white and red clover, and timothy. Wheat and barley have succeeded on such lands, after they have been supplied with abundance of calcareous earth; and the fiorin grass, (*Agrostis stolonifera latifolia*), seems likewise to be well adapted to that description of soil, when moderately surface-drained.

The first step towards the improvement of moss, or other wet or marshy peat soil, is to relieve it of all stagnant moisture. Wherever springs start up, they must be completely drained, and such open drains, or furrows, should be made on the surface of the moss, as may be necessary to free every part of it from superfluous moisture. In forming ridges on the moss, they ought to be raised no higher than to make the water fall readily into the furrows; and these should be carefully formed, so as to allow no water to remain any where on the surface of the moss land. If this be done, no farther draining is at all necessary, or can be of use, but the reverse. Soft black peat-earth, when drained, is often rendered productive, merely by the application of sand and clay as a top-dressing. When peat contains ferruginous salts, calcareous matter is absolutely necessary to fit it for cultivation. When mosses or bogs abound with the branches, or the roots of trees, or when the surface entirely consists of living vegetables, they must either be carried off, or burnt. In the last case, their ashes furnish ingredients calculated to improve the texture of the peat. For this soil, soap-ashes are found an excellent manure.

In Leicestershire, and other counties, there are great tracts of meadow land, which, in many instances, are the sites of lakes filled up, the soil of which is composed of peat and sediment; the former originally formed by aquatic vegetation, and the latter brought down by rains and streams from the upland. This forms a soil admirably calculated for grass ([88]).

The fens in Cambridgeshire, Lincolnshire, and several other districts in England, likewise consist of peat and sediment. They are pared and burnt for cole-seed, to be fed off by sheep, which, by their manure, enrich the soil. After two crops of grain, they are sown with grass-seeds, (two bushels of rye-grass, and eight or ten pounds of white clover), and remain in grass for five, six, or seven years ([89]); the longer the better. In the fens, beans and turnips have been cultivated, but have not been found to answer; nor can fen land be fallowed with advantage; for it does not bear much stirring. On such soils, potatoes, *and above all carrots*, have been tried as an intervening crop, and with much success.

The great object, however, is, to adopt the most proper management of fen or peaty land *for hay crops;* and here it is proper to mention a modern discovery of great moment. It is ascertained, that by suffering the second crop of grass, that might often with difficulty be converted into hay, to rot upon the ground, an immense produce of hay is ensured for the succeeding year, and that fen land may thus become a perpetual hay meadow. This important fact is corroborated by some experiments which have been tried near Oudenarde in Flanders, where the same effect has been produced, by leaving the second crop on the ground every second or third year: the grass produced the succeeding year, being of extraordinary length (20).

In Ireland, the improvement of peaty soils, from their immense extent, is an object of peculiar importance; and the greater part of them are capable of producing very valuable crops of roots or grain. Where the peat can be mixed with clay, by converting a portion of both into ashes, a crop of rape may be procured, along with which grass seeds may be sown; but great care must be taken, where that plan is adopted, to prevent the land from being injured by cattle *.

5. *Chalk.*—Chalky soils principally consist of calcareous matter, mixed with various other substances, in greater or less proportions. Where clayey or earthy substances are to be found in such soils, in considerable quantities, the composition is heavy and productive; where sand or gravel abounds, it is light, and rather barren.

The crops chiefly cultivated on chalky soils, are, pease, turnips, barley, clover, and wheat; and however much the soil is exhausted, it will produce sainfoin.

The chalky hills have seldom had proper attention paid to them. They are distant from the cattle-yards, and the roads to them lie up steep acclivities; consequently dung has very rarely been carried to them. The crops raised upon these heights, are drawn or carried into the vallies. Whether they are cultivated, or fed with sheep, they suffer in both cases: the corn is drawn from the hills to the barns in the valleys; and where they are in a state of grass, the sheep which feed on them during the day, are folded at night in

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* Where such soils are not capable of producing crops of grain, or roots, or even grass, they ought to be effectually drained and planted with Scotch fir, larch, or even ash. In that case, the tap roots ought to be cut off, to prevent their reaching stagnant water. The roots will then shoot horizontally to a great distance from the tree, but will never get below the dry, or dead part of the moss. A certain quantity of good earth, (loam or mould), should be thrown into the pit dug for the reception of the plant. This greatly promotes its growth, which otherwise may fail.

the lower grounds. This system of deteriorating the hills, ought to be counteracted, by cultivating green crops, and consuming them upon the land. Gluey as many of these hills now are, they may be rendered friable by animal and other manures.

The means of ameliorating the texture of chalky soils, are, either the application of clayey and sandy loams, or pure clay marl, or where the staple is deficient, the use of great quantities of peat, or of water-fed earth. The chalk stratum, mostly, or perhaps generally, lies upon a thick bed of black or blue tenacious marle, of a rich quality, which ought to be dug up, and mixed with the chalk, to cure its defects, as well as to enrich it (91).

The ashes of a sort of peat produced in some parts of Berkshire and Bedfordshire, of a red colour, and which abound with iron, are found to be highly beneficial to chalky soils, particularly when sown with trefoil, and other grasses. On such soils, these ashes are of use, not only for crops of barley, but likewise even of oats (92).

Chalky soils are in general fitter for tillage than for grazing; for, without the plough, the peculiar advantages derived from this soil by sainfoin, (one of the most valuable grasses we owe to the bounty of Providence), could not be obtained. The plough, however, ought not to extend to those fine chalky downs, (called ewe leases in Dorsetshire), which, by a very attentive management, during a number of years, have been brought to a considerable degree of fertility, as grazing land, and which are so useful to sheep in the winter season (93).

A chalky soil that has been in tillage, permits water to pass through it so freely in winter, and is so pervious to the sun's rays in summer, that it is the work of an age to make it a good pasture of *natural grasses*, more especially when the chalk lies near the surface. Hence, in the western counties of England, several thousands of acres of this soil, though not ploughed for thirty years, have scarcely any grass of tolerable quality upon them, and are literally worth nothing (94). Such soils ought to be cultivated, as a preparation for sainfoin, in the following manner: 1st year, Pare and burn for turnips, to be eaten on the land by sheep, with the aid of some fodder; 2d, Barley, to be sown very early with clover seed; 3d, Clover, eaten off by sheep; 4th, Wheat; 5th, Turnips, with manure; and, 6th, Barley with sainfoin. The corn crops must be carefully weeded, and in particular cleared of charlock. Under this system, which has been successfully practised by a celebrated Kentish farmer, (Mr Boys of Betshanger), the produce has been great, and the ground has been laid down in the highest order with sainfoin, or any other grass calculated for this species of soil ([95]). By adopting this system, many thousands of acres might be improved, which are now lying in an unproductive state ([96]).

6. *Alluvial Soils.*—These are of two sorts; one derived from the sediment of fresh, and the other from that of salt water.

Along the sides of rivers, and other considerable streams, water-formed soils are to be met with, consisting of the decomposed matter of decayed vegetables, with the sediment of these streams. They are in general deep and fertile, and not apt to be injured by rain, as they usually lie on a bed of open gravel ([97]). They are commonly employed as meadows, from the hazard of crops of grain being injured, or carried off by floods.

Those fine alluvial soils, arising from the operations of salt-water, (called *salt marshes* in England, *carses* in Scotland, and *polders* in Holland and Flanders), are composed of clay, washed off by running water, and deposited on flat ground, on the shores of estuaries, where they are covered by the reflux of the tide, but often protected by embankments from any risk of injury from such inundations. They are frequently enriched with marine productions, which render them peculiarly valuable ([98]). When analyzed, they often produce the same ingredients, or nearly so, as mould, with, in some cases, a mixture of calcareous earth. They generally have a smooth, level surface, and being deep in the staple, they are well adapted for the culture of the most valuable crops. Hence wheat, barley, oats, and clover, are all productive on this species of soil; which is likewise peculiarly well calculated for beans, as the tap-root pushes vigorously through it, and finds its nourishment at a great depth. From the great mass of excellent earth, the fertility of these tracts is nearly inexhaustible; but from their low and damp situations, they are not easily managed. Lime, in considerable quantities, is found to answer well upon this species of soil.

7. *Marshes.*—Some low grounds are apt to be overflowed either by rivers or by the sea, and hence are characterised by a considerable degree of wetness. Those on the sea-shore, are rarely brought into cultivation, the herbs they produce being of considerable value, not only for feeding stock, but for curing them of disease. Places covered with water, either

occasionally, for a part of the year, or constantly, may be suited to grow different species of useful plants.

8. *Loam.*—Where a soil is moderately cohesive, less tenacious than clay, and more so than sand, it is known by the name of *loam* (99). From its frequency, there is reason to suppose that, in some cases, it might be called an original soil. At the same time, a constant course of tillage for ages, the application of fertilizing manures, and where necessary, the admixture of any particular substance in which the soil is deficient, (as clay with sand, or sand where clay predominates), will produce a species of loam (100).

Loams are the most desirable of all soils to occupy. They are friable;—can in general be cultivated at almost any season of the year;—are ploughed with greater facility, and less strength than clay;—bear better the vicissitudes of the seasons;—and seldom require any change in the rotation adopted. Above all, they are peculiarly well adapted for the convertible husbandry; for they can be changed, not only without injury, but generally with benefit, from grass to tillage, and from tillage to grass. They should not, however, be kept in tillage too long, nor, while they are in cultivation, should two white crops be taken in succession.

Loams are of various sorts: 1. Sandy; 2. Gravelly; 3. Clayey; 4. Calcareous; 5. Peaty; and 6. That mixture of soil known under the name of a Hazel loam.

1. A sandy *soil* is easily distinguished from a sandy *loam* (101). The former is always loose and crumbling, having no adhesion, either when it is wet or dry. But sandy loams, having a portion of clay or earthy matter mixed with the sand, become more adhesive than pure sand; and though they do not, like clay or loam, become so cloddy as to require to be reduced by machinery, yet they adhere so much, as to form a proper seed-mould under the harrow.

A mellow, rich, crumbling, sandy loam, adhesive enough to fear no drought, and friable enough to strain off superfluous moisture, if incumbent on a sound subsoil, is peculiarly profitable, being managed with much less expense than any other soil, and raising, with advantage, every species of crop that the climate will admit of (102).

2. Gravelly loams, when warm, sound, and dry, or free from springs, are useful soils, more especially in wet seasons and climates.

3. A clayey or stiff loam, or brick earth, however poor and cold in its original state, if it be well drained according to the Essex system, occasionally fallowed, and highly ma-

nured, will yield great crops ([103]). It is found well adapted for the dairy in Cheshire ([104]).

4. Calcareous loams have chalk for their basis, and are admirably calculated for the production of sainfoin.

5. Peat, in some of its varieties, may likewise be converted by culture, into a species of black soft loam, and in that state, it becomes highly fertile and productive.

6. A hazel loam, is a mixture of various soils, which assumes a brownish colour, and is reckoned uncommonly fertile.

Rich loams, besides the other crops usually cultivated in this country, will produce hemp and flax in the greatest perfection and abundance; and in such loams, where the subsoil is both dry and open, lucerne might be more generally grown than it is, in preference to other grasses, and would prove greatly superior in produce, to what are called permanent pastures ([105]).

General Remarks on Soils.

Before the subject of soil is dismissed, there are some miscellaneous particulars which merit attention; as, 1. The means of ascertaining the composition of soils; 2. The nature of mould, so essential for their fertility; 3. Their colour; 4. The importance of cultivating good soils; 5. The necessity of keeping them in a fertile state; 6. The advantages of a deep soil; and, 7. The general principles on which their improvement may be effected.

1. That the most efficient methods for improving soils may be adopted, it is necessary that their composition should be known. A distinguished philosopher has suggested a plan for that purpose, which can easily be carried into effect, by any person at all conversant in chemical researches ([106]). The generality of farmers, however, have not the means of entering into such researches; yet they are able, by observation and experience, to discover the most important deficiencies of the soil they cultivate. This may be effected, by comparing their own soils with each other, and with the most fertile in their immediate neighbourhood. The great object they ought to keep in view is, to render a soil capable of receiving, and retaining such a due quantity of moisture, as may be sufficient to nourish the vegetables that grow in it, and, by proper drainage, to procure the means of throwing off any superfluous water that might prove injurious ([107]).

2. Mould principally arises, from the decomposition of the roots and leaves of vegetables, on grass land, and the

stubble, and roots of grain crops, on arable [108]. It is an essential ingredient in all fertile soils, and is of great use, by attracting and retaining a due proportion of moisture, in the mixed mass which the soil contains. Its formation on grass lands is extremely slow; for it is calculated, that it proceeds at the rate of only one inch in a century [109]. Considerable accumulations of mould however, may be produced from the leaves of trees, amassed for a number of years, and rotted on the surface [110.] When, in addition to vegetable, there are animal substances in a state of decomposition, the soil is distinguished for its fertility.

3. It is of essential consequence, when the surface is bare, and exposed to the rays of the sun, that the colour of the soil should be such, as to attract and absorb the greatest heat from the sun and the atmosphere, more especially in spring.

Soils are of various colours. The principal are white, black, and red. Uniformity of colour, is always a more favourable indication of fertility, than when they are *mottled*, which is generally owing to an inferior subsoil. The soil of the Carse of Gowrie, in Scotland, so celebrated for its fertility, is of a pale colour, from a white clay which forms its subsoil.

White stiff clays are heated with difficulty, and being usually very moist, retain their heat only for a short time.

A black soil, containing much vegetable matter, is most easily heated by the sun and air. Its temperature has increased from 65° to 88° by exposure to sunshine for an hour. A chalky soil, under the same circumstances, was heated only to 69°. In the shade, however, the black mould lost its heat more rapidly [111].

The red colour in some soils proceeds from a combination of iron; but it does not appear that a reddish colour is defective in fertility; on the contrary, much land, where the soil, subsoil and minerals are nearly of the colour of brick, is fertile, and produces excellent crops. Red soils are greatly improved by calcareous manures, as the chalky are by ashes containing a considerable proportion of iron.

4. It has been justly remarked, that too much can hardly be paid for a good soil, and that even a low rent will not make a poor one profitable. The labour of cultivating a rich and a poor soil is nearly the same; while the latter requires more manure, and consequently is more expensive. Poor soils, at the same time, may have such a command of lasting manures, as lime or marle, or even of temporary

sorts, like sea-weed, or the refuse of fish, as may render it profitable to cultivate them ([112]).

5. It is a wise maxim in husbandry, that the soil, like the cattle by which it is cultivated, should always be kept up in good condition, and never suffered to fall below the work it may be expected to perform ([113]).

Probably, in ordinary cases, in ground of middling fertility, and with a good climate, the substances which vegetables collect from the atmosphere, will nearly compensate for what is sold off in *corn* and in *live stock*, provided there is a suitable proportion of grain, and of green or fallow crops. It is established, however, as a fact, that where other productions are sent off, besides grain and live stock, or where straw and grain for forage are repeatedly abstracted, without any equivalent being supplied, the soil soon loses its fertility ([114]).

6. Depth of soil is of great importance. The roots of some plants, as carrots, and wheat ([115]), go deep into the earth, and often require all the moisture it contains; but depth is likewise desirable, where such plants as the grasses, (which in general penetrate but a short way), are sown. If the soil be thin, water, in wet weather, is apt to lie on the subsoil, and to injure the roots of the plants; and in dry weather it may be too suddenly evaporated. Whereas when the soil is deep, in wet weather the rain escapes downwards, and the plants sustain no injury; and in dry weather, if the moisture is exhausted at the top, new moisture arises from the bottom, and makes up for the deficiency.

7. There are various modes of improving soils. When they contain acids, or salts of iron, they may be ameliorated by the application of lime or chalk. The sulphate of iron is thus converted into a manure. If there be an excess of calcareous matter in the soil, as in chalky land, it may be improved by the application of sand or clay, or earthy substances. Soils too abundant in sand, are benefited by the use of clay, or marl, or vegetable matter; and a deficiency of vegetable or animal matter, must be supplied by enriching manures.

The substances necessary for improving the texture of soils, may frequently be discovered in their immediate neighbourhood. Coarse sand is often found under chalk, and almost always near it. Beds of sand and gravel, are commonly found below clay, while clay and marl frequently occur below sand.

The labour and expense of improving the texture or constitution of the soil, it has been justly observed, are amply repaid, by the great and permanent advantages which they produce. Less manure is afterwards required;—the crops cultivated, are more independent of particular seasons;—while the capital thus expended, secures the future fertility, and consequently the permanent value of the land ([116]).

Sect. III.—*Subsoil* ([117]).

The value of a soil depends much upon the nature of the subsoil, or under-stratum. On various accounts the properties of the latter merit particular attention. By examining the subsoil, information may be obtained in regard to the soil itself; for the materials of the latter, are often similar to those which enter largely into the composition of the former. The nature of the soil, however, is necessarily altered, by the various substances mixed with it, in the course of its cultivation. The subsoil may be of use to the soil, by supplying its deficiencies, and correcting its defects ([118]). The hazard and expense of cultivating the surface, are often considerably augmented by defects in the under-stratum, which, however, may in some cases, be remedied ([119]). Disorders in the roots of plants, are generally owing to a wet or barren subsoil.

Subsoils are, 1. Retentive; or, 2. Porous.

1. Retentive subsoils consist of clay, or marl, or of stone beds of various kinds.

A retentive, clayey, or *tilly* ([120]) subsoil, is in general found to be highly injurious. The surface soil is soaked with water, is ploughed with difficulty, and is usually in a condition unfit for the exertion of its vegetative powers, until the superabundant moisture which has accumulated during the winter be exhaled. By the water being retained in the upper soil, the putrefactive process is interrupted, and manures are restrained from operating; consequently the plants make but little progress. Hence, the produce of such a soil in grain, is of inferior quality, and when in grass, its herbage is coarse ([121]).

A clayey subsoil, however, may sometimes be of material advantage to a sandy soil, by retaining moisture in such a manner, as to supply what is lost by evaporation, and the consumption of plants ([122]). Alluvial subsoils are those which can be raised and mixed with the soil, to the greatest advantage.

When soils lie immediately on rock, they become sooner dry, by the moisture either sinking or evaporating, than when the subsoil is clay, or any retentive substance. If the rock next the soil is sandstone, it will allow the water to filter; but the soil over that species of rock is never of the best quality. Soil resting on whin-rock, or on limestone, is never much hurt by moisture, as the latter sinks into the rock, and the soil is always of much better quality, than similar soil resting on *till* or on freestone ([123]).

2. A porous subsoil, is uniformly attended with this advantage, that by its means, all superfluous moisture may be absorbed ([124]). In regard to its allowing the fibrous roots of vegetables to extend deeper in search of moisture or nutriment, that is often pernicious rather than otherwise, and must be checked by the useful operation of treading.

Below clay, and all the varieties of loam, an open subsoil is particularly desirable. It is favourable to all the operations of husbandry;—it tends to correct the imperfections of too great a degree of absorbent power in the soil above;—it promotes the beneficial effects of manures;—it contributes to the preservation and growth of the seeds;—and ensures the future prosperity of the plants ([125]). Hence it is, that a thinner soil, with a favourable subsoil, will produce better crops, than a more fertile one, incumbent on wet clay, or on cold and non-absorbent rock.

Lands whose substratum consists of clean gravel, or sand, can bear little sun, owing to their not having the capacity of retaining moisture, and their generally possessing only a shallow layer of vegetable mould. In England, this soil was formerly called *rye-land*, being more generally cropped with that species of grain, than any other. When such soils are cultivated for barley, they should be sown early, before the ground becomes very dry; and if it becomes so, the seed should be abundant, and steeped for two or three hours in water, or in the juice of a dung heap, that its simultaneous germination, and ripening at the same time, *may be secured* ([126]).

When soils with a retentive bottom, are either in fallow, or preparing for a green crop, the *miner* should follow the common plough. This is a species of plough not mounted with mould-boards, for it is intended merely to loosen the subsoil, and not to raise it. When the subsoil is thus loosened, it absorbs the wet. In process of time, the manure gets to that loosened earth, improves it, and in a few years, the productive soil is enlarged.

On the whole, there is a most intimate connexion between the soil and subsoil; and the fertility of the former, essentially depends on the quality of the latter. It is indeed evident, that the nature of the subsoil, as well as of the soil, must be ascertained, before a farmer can, with propriety, select his plants, determine on the species of manure to be employed, or arrange his course of cultivation ([127]). Such investigations therefore, are of the highest importance to agricultural economy. They may be the means of explaining peculiarities and anomalies, which cannot at present be accounted for, and may suggest the best methods of improving a soil, by correcting the defects in its constitution, and removing the causes of its sterility. An inquiry, conducted on a great scale, and aided by the public, might thus lay a *basis of general improvement*, incomparably superior to any that has hitherto been attempted ([128]).

SECT. IV.—*Elevation.*

THE value of a farm must likewise depend upon *its elevation.* Where the ground is high, it must be more difficult and expensive to convey manure to it, and to carry on the other operations of husbandry. Land also, in the same parallel of latitude, other circumstances being nearly similar, is always more valuable, in proportion to the comparative lowness of its situation, in consequence of the superior quality of its produce. In the higher districts, the herbage is less succulent and nourishing, and the reproduction slower, when the land is in grass; while the grain is less plump, runs more to straw, ripens less perfectly, and is later in coming to maturity ([129]).

It has been calculated, that in Great Britain, *sixty yards of elevation* in the land, *are equal to a degree of latitude;* or, in other words, that sixty yards perpendicularly higher, are, in respect of climate, equal to a degree more to the north ([130]).

Many extensive countries have no perceptible rise. These have their advantages, from uniformity of soil, where it is rich. In other districts, the surface is of a waving description; an inequality which contributes much to the ornament of the country, by the agreeable relief which the eye constantly meets with, in the change of object, while the declivity which prevails more or less in every field, is favourable to the culture of the land, by allowing a ready descent to any water with which the surface may be encumbered [131]. Abrupt elevations however, very much increase the labour and expense of cultivation; and the soil, in the highest parts of the field, becomes shallower, by every operation of tillage.

Hilly countries have many disadvantages. On their sloping sides, the finer parts of the clay and mould are washed away, while the sand and gravel remain. Hence in such districts the soil often wants a proper degree of tenacity for supporting corn crops [132]. A great part of the manure that is applied, in such situations, is likewise soon lost. From various causes also, they are colder than the plains. They are more distant from the heat of the great mass of the earth, and in a manner cut off from its influence. The atmosphere around them is liable to be often set in motion; and thus any heat which may occasionally be accumulated, is rapidly carried away. The attraction of moisture by high grounds, is another cause of their being colder.

In considering the crops to be raised on any particular farm, much attention ought to be paid to the quality of the soil, its natural shelter, and its height above the level of the sea. In regard to elevation, it has been found, that in latitudes 54 and 55, wheat cannot be sown at an altitude of more than 500 feet, with any probable chance of profit; and even at that height, when the soil is heavy, and the situation unsheltered, the grain will be late in ripening, and of inferior quality. But where the soil is a sandy loam, in good condition, and the ground sheltered by hills, wheat of a medium quality has been produced, in favourable seasons, at from 700 to 800 feet above the level of the sea.

In the warm vales, among the hills, in the upper ward of Lanarkshire, large crops of oats have been reaped, and grain of good quality produced, in situations from 1000 to even 1200 feet above the level of the sea. Oats have likewise been grown at Dubrach, in Braemar, (Aberdeenshire), at 1294 feet, and at Leadhills, in Lanarkshire, at 1564 feet of altitude; but these were only in small patches, richly manured, and the grain was seldom fully ripe, or properly harvested [133].

In England, from 600 to 700 feet may be reckoned the usual maximum of elevation, for the more common sorts of grain; and in backward seasons, the produce at this height is of small value, and sometimes yields nothing but straw [134]. In calcareous soils, however, (as in the Gloucestershire and

Yorkshire Wolds), from their superior warmth, compared with cold clays, or peat, barley has been grown to great perfection, at an elevation of 800 feet above the level of the sea ([135]). Experiments have been tried, to raise corn crops, at even a higher elevation, on the celebrated mountain Skiddaw in Cumberland, but the attempt was unsuccessful.

On this subject, it is proper to add, that on the second class of mountains in the county of Wicklow, in Ireland, where no other grain is considered to be a safe crop, *rye is cultivated with success* ([136]).

Sect. V.—*Aspect, or Exposure.*

In hilly or mountainous districts, this is an important subject of attention to the farmer, more especially where the climate is unfavourable. It is proved in a variety of instances, both in the Central Highlands of Scotland, and in other parts of the kingdom ([137]), that where the aspect of a hill is towards the north, the soil is more fertile, than when it lies with a southern exposure. This is attributed to the variations from frost to thaw in the spring months, which are greater in a southern, than a northern aspect. Hence, while the soil to the north remains locked fast, and secured from waste, the other is loosened by the sun, and carried off by showers falling in the intervals of thaw. Soils also which face the south, are more liable to have their substance carried away by heavy rains, which are generally impelled from the south and south-west ([138]). Nor is this remark restricted to the climate of this country; for it has been most distinctly stated, in communications inserted by Dr Thomas Thomson in his Annals of Philosophy, that in the climate of Nice, the south side of a hill is so much warmer than the north, that orange trees will flourish much higher up in the former than in the latter.

But though soils with a northern exposure often produce the heaviest crops of grass and hay, yet on those which have a southern aspect, from their possessing a more genial climate, and from the earlier and more powerful action of the sun, both corn and grass are harvested earlier ([139]); and superiority of quality, thus compensates, for any inferiority in the quantity of the produce.

Sect. VI.—*Situation.*

The system of farming to be adopted on any particular farm, and the expense attending it, must likewise depend, 1. On its situation in regard to markets; 2. On the facility with which its produce can be conveyed, where a contiguous market is wanting; 3. On its vicinity to manure; and, 4. To fuel ([140]).

1. The advantages resulting from vicinity to a market, or to a large town by which that is insured, are very great. Some crops, as those of potatoes, turnips and clover, are frequently sold *on the ground*, without any farther trouble or expense to the farmer; and great quantities of manure may be purchased at a moderate expense. In such situations also, there is a ready sale for every article the farm can produce; and the articles sold, are not only brought to market at a small expense, but the payment is immediate ([141]). For all these reasons it is contended, and apparently with justice, that the neighbourhood of a large town, is the most profitable spot to farm in, notwithstanding the high rent of land, and the great expense of labour ([142]).

Where markets are not at hand, the farmer ought to take into consideration, what articles will best suit those at a distance, to which his produce must be sent. In such a situation, unless there are facilities for the conveyance of so bulky an article as corn, by good roads, or by water-carriage, it is advisable, instead of cultivating grain, to attend either to the dairy husbandry, or to the breeding of stock, which can be fattened in other districts where good markets are more likely to be met with. This plan, by which the dairy, the breeding, and the fattening of stock, are made distinct professions, is highly beneficial to the country at large. Stock can be reared cheaper in remote districts, than where land is dear, and labour high. On the other hand, the purchaser of lean stock, avoids the expense and risk of breeding great numbers of animals. His attention is not distracted by a multiplicity of objects. He can alter his system, from cattle to sheep, or from sheep to cattle, as is likely to be most profitable. His business is simplified, and the capital he lays out is speedily returned. The division of professions between breeding and feeding, (though they may be united in circumstances peculiarly favourable), is, on the whole, a most important link in the progress of agricultural improvement ([143]).

2. In regard to facility of conveyance, it cannot be dispu-

ted, that the promoting of internal communication, by means of roads, bridges, iron railways, canals, rivers rendered navigable, and harbours, is the most beneficial means that can be adopted for the improvement of a country. It is well known, that the best cultivated districts are those, which have the advantage of possessing the greatest facility of internal communication; without which agriculture languishes in the most fruitful districts, while, with it, the most ungrateful soil soon becomes fertile ([144]).

3. Another object deserving consideration is, the situation of the farm in regard to manures; for an easy access to lime, chalk, marl, sea-weed, &c. is of essential advantage to cultivation. The rate at which these articles can be procured, their quality, their distance, and the expense of conveyance, are likewise of importance. Farms for example, possessing the advantage of sea-weed contiguous, and in abundance, can pay from 15 to 20 *per cent.* more rent, per acre, than otherwise could be afforded ([145]).

4. In the cold and moist regions of Europe, vicinity to fuel, and its quality, are important considerations to the farmer. In the same county, even in England, the difference of expense is often material. In the Hebrides, from the moistness of the climate, the expense of fuel is reckoned equal to a fourth part of the rent of the land; and farmers who pay L.150 *per annum*, would, in some cases, give L.200, if the landlord would supply them and their servants with fuel ([146]). Where a farmer is under the necessity of using peat, from the labour attending the cutting, spreading, drying, and conveying it from a distance, several weeks of his horses and servants are exclusively devoted to these purposes; and much valuable time is lost, which ought to have been employed in the cultivation of his farm. It has been well remarked, that many farmers, to save five guineas on coal, often expend twenty, in thus misapplying the labour of their horses ([147]). Where wood is used, it occupies a great deal of ground, that might often be cultivated to advantage; and it is not of a lasting quality ([148]). Coal is preferable, for general purposes, to every other species of fuel; and besides its domestic application, its superiority for burning lime, that important source of fertility, is an object of great moment. The tenant, therefore, who resides in the neighbourhood of coal, more especially if limestone, or calcareous substances, are at no great distance, farms at less expense, can afford to pay a higher rent, and may derive more profit from the land he cultivates, than if in these respects he were differently circumstanced.

Sect. VII.—*Size of Farms.*

Among the preliminary points which demand the particular attention of any individual, about to commence the profession of agriculture, the size of the farm which he proposes to occupy, is of peculiar importance. If it is beyond his capital to cultivate or improve, he can derive no profit by taking it. On the other hand, a small occupation, may not be worthy of his attention, or capable of producing a sufficient surplus for his comfortable subsistence.

The size of farms, in general, is a subject on which volumes have been written, and respecting which, a great diversity of opinion prevails. It is impossible to lay down any precise or universal standard, as so much depends upon the nature and situation of the country, whether uncultivated or otherwise;—the size of estates in it ([149]);—the character, skill, and capital of the farmer;—and a variety of local circumstances. At the same time, it is necessary to discuss the relative advantages of the different sizes, that the subject may be the better understood.

Arable farms may be divided into three sorts: 1. Small farms under 100 acres; 2. Moderate-sized farms, from 100 to 300 acres; 3. Large farms, from 300 to 1000 acres and upwards, of land fit for cultivation.

1. *Small Farms.*—When the object of a farmer, was merely to procure a maintenance, (and formerly it was little more), and agriculture was not pursued, like manufactures and commerce, as a means of acquiring wealth, small farms were adequate to the purpose ([150]). But the case is now widely different. The expense of labour is so great, and the rent of land so high, that the profits of a small farm, are not sufficient, with the utmost frugality, or even parsimony, to maintain a family with comfort. However injurious, therefore, it may be, to the production of a numerous and healthy population, large farms are increasing, and must increase, in order to afford their holders a subsistence; and the tenants of smaller possessions will be under the necessity of devoting themselves to other branches of industry ([151]).

Among the arguments in favour of small farms, the following are particularly dwelt upon: 1. That where such farms are to be obtained, industrious individuals, possessed of small capitals, have an opportunity of following the profession of a farmer, to which they would do credit, but from which, unless small possessions are to be had, they would necessarily be excluded; 2. That young men are enabled to commence farming on a moderate scale; for though possessed of capital, or regularly bred to the profession, they are so apt to fall into errors, that they ought not at first to undertake the management of too extensive a concern; 3. That in districts where the inhabitants possess but small capitals, they are not tempted to take larger farms than they can manage to advantage; for where farmers embark too largely at first, they often go to ruin; and, 4. That if agriculture should cease to flourish, it is more likely to find persons fit to occupy small farms, than those of larger dimensions.

Among small farms may be included, those lots of land, cultivated for health or amusement, by the inhabitants of small towns and villages, who likewise derive other advantages from the produce thus raised, more especially when they cultivate potatoes. These lots are generally of so moderate an extent, that they can be managed by spade culture. This, with hoeing and dressing the crop through the summer, and digging it up in autumn, affords a healthful and agreeable out-door exercise to tradesmen, who are necessarily much confined to their houses; and the crop which they thus raise at a moderate expense, forms a considerable part of their provision, for three or four months, at the end of autumn and beginning of winter. After potatoes, it is now become a common practice to sow wheat, which usually yields an abundant return.

It is astonishing that so beneficial a practice, should not have been introduced into England, as it is found to have a most advantageous influence, in regard both to health and morals. Manufacturers and others, by thus dividing their time between the labours of the field, and their occupations within doors, become healthy and vigorous; their offspring are more robust, and growing up in habits of temperance and industry, are strangers to those courses of dissipation, idleness, and vice, to which youth, in great towns, are so much exposed, and so often fall a sacrifice. The produce raised on these lots also, furnishes some security against any temporary want of employment, *when trade is dull.*

2. *Moderate-sized Farms.*—These are well calculated, 1. For the dairy system; 2. For the neighbourhood of large towns; and, 3. For persons whose capital is not abundant.

1. There are few trades, in which a small capital can be employed to greater advantage, than in a dairy farm ([152]); yet

there is no branch in agriculture, where such constant and unremitting attention is required. This necessary attention is not to be expected from hired servants; but the whole concern may in a great measure be managed, or at least superintended, by the farmer's wife and daughters, by whose aid it may be rendered productive. Nor is attention within doors sufficient; if cows are fed out of doors, they must not be compelled to travel to their pasture, far from the place where they are milked ([153]). Moderate-sized farms, therefore, are in this respect advantageous; and are still more likely to answer, when the farmer considers his cows as his pride;—when he takes delight in shewing his stock to his friends;—in detailing their birth and progress;—in dwelling on the condition to which he has brought them;—and in pointing out the beauties of their progeny, and the excellence of their produce ([154]).

2. In the neighbourhood of towns, moderate-sized farms are general. This necessarily results from the high rents paid in such situations; the shortness of the leases usually granted; and the necessity the farmer is under, of selling, in small quantities, the articles produced on his farm. Hence it is, that in Flanders, which is full of large towns and villages, the farms are moderate in size. This is likewise of advantage to the towns, for where there is a great number of farmers, there is more competition, lesser objects are attended to, and the markets are, at least with the smaller articles, more regularly and better supplied.

On this subject it has been remarked, that farmers in the vicinity of large towns, resemble *retail shopkeepers*, whose attention must be directed to small objects, by which a great deal of money is got, the greater part of which would be lost, without the most unremitting attention. The farmer at a distance from markets, who cultivates land on a great scale, may, on the other hand, be compared to *a wholesale trader*, who, as his profits are less, requires a greater extent of land, for the purpose both of engaging his attention, and of enabling him to support that station of life in which he is placed. There is this difference also, between farmers in the neighbourhood of towns, and those who reside at a distance from them, that the former find it more profitable, to sell their produce, even such bulky articles as turnips, potatoes, clover, hay, and straw, than to fatten cattle for the butcher; and they are enabled to do so, without injury to their farms, as they can procure dung in return. Indeed they are commonly bound to do so by their leases, when these articles are sent to market ([155]).

3. In all districts where capital is not abundant, moderate-sized farms ought to be preferred. The size of a farm ought always to be in proportion to the sum which the holder can afford to lay out in stocking it. This rule ought in a special manner to be observed, when the circulation of a country is reduced;—when markets are consequently low;—and when it is not easy to raise a considerable sum of money, even on good security, should an unexpected demand occur, and no sales have been made to meet it. Where such circumstances take place, a large farmer may be involved in difficulties, or reduced to ruin, which the occupier of a moderate farm, whose business is conducted on a smaller scale, may escape.

3. *Large Farms.*—Wherever agriculture is followed as a distinct profession, a farm ought to be of such a size, as to furnish regular employment, not only to the farmer himself, but also to the servants and labourers employed by him, in order that the greatest possible profit may be derived from their labour, at the least possible expense. It is evident, that this can only be accomplished on a farm of considerable extent, where judicious rotations of crops are adopted, and where the economy of the farm is so conducted, that too much work does not occur at one season of the year, and too little at another; in short, where that division of labour, from which manufacturers have derived such essential benefit, is applied to husbandry ([156]).

The arguments, however, which have been adduced in support of large farms, and the objections which have been urged against them, and in favour of small farms, are so numerous and important, that it is proposed to state them in a separate paper in the Appendix ([157]).

The chief cause of the enlargement of farms was, the introduction of those arts, by which bodily labour has been so wonderfully saved, and fewer hands rendered necessary to carry on cultivation.

Formerly, the farmer was but little occupied, except in seed-time and harvest; and his whole labour, during winter, was in threshing and preparing his crop for sale. In summer, except when peat was the fuel, he was literally almost idle. But in these enlightened times, he has constant occupation almost every day in the year, in ploughing,—sowing,—reaping,—and manuring his fields, or conveying his crop to market; and when the improvement of roads,—

implements,—modes of labour, &c. are considered, it explains at once, how large farms were originally introduced, and have since been so generally established.

In regard to the general question, it cannot be doubted, that in an extensive tract of country, there must always be, owing to a variety of circumstances, a considerable diversity in the size of farms; but at the same time, that there is a regular progress, tending, first, to augment, and afterwards to diminish their general extent.

At first, when the art of agriculture is in its infancy, farms must be small, because there is neither sufficient capital for the cultivation, nor skill for the management of large occupations; nor are large farms necessary in that period of society, because it is seldom that great numbers of inhabitants are collected in towns, who must be provided with food. Besides, a feudal chieftain is desirous of increasing the number of his followers; and for want of other sources of employment, a father has no other means of providing for his sons, when they remain at home, than by giving them a share of his farm. In the course of a few generations, therefore, a farm of even a considerable extent, is thus frittered down into very trifling possessions. Hence there is a strong tendency, in the first stages of agriculture, to have farms of a small size, and to have a number of these united together, under what may be called the village system.

In process of time however, as population advances,—as capital increases,—and as skill improves, farms are enlarged; and it is found by experience, that one man can cultivate any given extent of country, (say from 300 to 500 acres and upwards), at less expense, can raise a greater produce, and can afford a higher rent, than a number of small occupiers. During this stage of the progress, farms are conjoined, and the farmer of skill and capital, not only rents tracts of country in his own immediate neighbourhood, but is also tempted to speculate even in remote occupations. Farms thus increase to a very large extent, and indeed attain a size, which, at first sight, appears calculated, (unless where it is the practice to have married servants, or the culture is of a very superior description), materially to diminish the number of persons, deriving their subsistence from the cultivation of the soil.

Two circumstances, however, afterwards take place, which have a strong tendency again to diminish the size of farms.

1. As the great inducement of any individual to enlarge, as far as he can, his concerns in agriculture, is owing to

the cheapness of land, and to the profits derived from an employment, in which he unites skill to capital; so, on the other hand, when by competition, the rent of land increases, and when, from various causes, many competitors appear, he has then no inducement to continue in the occupation of more land, than he can conveniently and profitably manage. He diminishes therefore the extent of his concerns, by giving up some of his farms to the proprietors, or establishing branches of his own family on them, or subletting some of them, if he be entitled to that privilege.

2. In the vicinity of towns, and on all lands approaching to garden culture, the occupier has so many minutiæ to attend to, that a large farm becomes unsuitable. In such situations, farms necessarily become smaller; and indeed, as the rent of land rapidly increases, a great extent of it would prove a most hazardous speculation.

Thus it appears, that the size of farms, must in a great measure depend, upon *the circumstances of a country*. What is a proper size in one district, is not so in another; and what is a proper size at one time, is not so at another, even in the same district. On the whole, however, that size, whether small, or moderate, or large, is to be preferred, for which there is, in any particular district, the greatest demand at the time. This demand insures, from competition, an adequate rent; and while the proprietor thus obtains the value of his land, the public are also benefited, the greatest possible produce being procured from the soil, owing to the superior industry and exertion required on the part of the farmer ([158]).

Sect. VIII.—*Tenure, whether in Property or on Lease.*

In this Section it is proposed to examine, the advantages and disadvantages attending the occupation of land, either by the proprietor himself, or by tenants holding under him.

1. *Proprietors occupying their own Land.*

It is certainly in various respects attended with public advantage, that a large proportion of the soil, should be the property of one class of the community, and in the occupation of another. In some of the American States, where, from a scarcity of population, leasehold tenure is hardly known, the land is often so much exhausted by the inattention of the owners, who think they may take any liberty with their own property, that in many districts, the crops of wheat, do not exceed an average of seven or eight bushels per acre ([159]). How different is the case in this country, where the owner, instead of cultivating his own fields, lets them to another! A careful landlord, indeed, considers himself as a trustee for his family, and for the public. He will not suffer his fields to be exhausted, by improper management or injudicious rotations; and when he grants a lease to a tenant, it is either to a person in whom he can safely place confidence, or under such covenants, which in fact are rent, as are the most likely to prevent, that great source of public wealth, the soil of the country, from being injured by improvident management. It must be admitted, however, that such covenants are often very injudiciously drawn up.

When a tenant also, has a rent to pay to a landlord, it has a strong tendency to render him industrious. Without that spur to exertion, he would not take half the pains he usually does, to cultivate his farm, or to supply it with stock. The burden of rent is likewise attended with another advantage; for in order to be enabled to pay it, the farmer finds it necessary to supply the markets more regularly. When persons have no such stimulus, they are induced to keep up their produce, that they may enhance its value.

Besides, a tenant who cultivates the soil as a profession, has but one object in view; and he is therefore more likely to manage the concern better than a proprietor, who has often other avocations to distract his attention. Not only is the tenant necessarily more attentive to his business, but he carries it on at less expense;—his cattle and servants do more work;—the produce of his farm is more carefully looked after;—and no money is expended, without the prospect of an adequate return. Expensive improvements, such as erecting commodious buildings, making roads, inclosing, draining, irrigating, and perhaps a very great application of calcareous manures, may be advantageously executed by the landlord; but in regard to raising the products of the soil, by judicious rotations of crops, complete aration, abundant manuring, selection of the best seeds, &c. an intelligent farmer has evidently an advantage ([160]).

As a proof of the justness of these doctrines, it is a well-known fact, that small proprietors, when they are men of sense and ability, frequently let, or sell their own estates, and take the lands of others on lease; knowing well, that if they were to reside on their own property, they would be tempted to live like gentlemen, and to indulge in idleness and inactivity ([161]). Instances also have not been wanting, where, owing to negligence, or other circumstances, the owner of a small estate has been obliged to sell it, and having afterwards hired the same land to farm, at a fair rent, has done well ([162]).

When the proprietors of considerable estates, cultivate their own land, they may have one of five objects in view: 1. Accommodation; 2. The pleasure of farming; 3. The profit that may attend it; 4. To make useful experiments; and, 5. The general improvement of their property.

1. It is not only a healthy, but a most useful employment, for gentlemen residing in the country, to have some land in their own possession, for the purpose of providing themselves with various articles which their families may require. Perhaps those articles might often be purchased fully as cheap at market; and it might be more profitable to the proprietor, to let the land at a fair rent, than to occupy it himself; but the occupation of land is a source of rational amusement, and it is desirable for every proprietor residing in the country, to have a spot which he can call his own, and on which he and his family can take air and exercise. Besides, if attention to a large extent of arable land be found inconvenient, so much corn need only be raised by a landholder, as may be necessary for his own purposes; and after his fields are inclosed, and laid down to grass, he may let them to farmers or graziers, reserving only what is absolutely necessary for his own accommodation ([163]). What the extent of such accommodation land should be, need not be here discussed, as it depends, upon the establishment kept up by the proprietor, the portion of time spent by him in the country, and the degree of superintendence that he can give to his farm.

2. When operations of agriculture were first attempted, it was for the purpose of procuring *the mere necessaries of life*; but when these were once obtained, conveniencies and comforts were next sought after, and ultimately refinements. Hence agriculture, which originally was considered a rude and simple source of employment, became, in process of time, *a liberal art*, capable of contributing to improve the scenery of a rich domain, or to shelter and adorn the residence of the great and powerful ([164]). This led to the introduction of *ornamental agriculture*, as distinguished from the useful. The distinction between them is, in gene-

ral, abundantly obvious. The scheme of culture which a gentleman may pursue in his park, or on lands near his seat of residence, is generally very different from that which a husbandman should adopt in his fields. The principle of the former is taste, that of the latter, thrifty management, or economy; the characteristic of the former is *ornament*, that of the latter, *utility*; and the object of the former is *pleasure*, that of the latter, *profit*. When the latter object is pursued on an extensive scale, it becomes a serious employment, requiring constant and unremitting attention ([165]).

3. Though the owners of estates, who cultivate their own lands, for arable crops, sometimes exhibit a degree of spirit and application productive of the most beneficial results, yet their profit, generally speaking, is much less than if the same land were occupied by a farmer. Proprietors rarely attend to all those minutiæ which a corn farmer must not neglect. Neither do they regularly oversee their servants, examine the state of their working cattle, attend fairs and markets, nor personally superintend the progress of all their farming operations. These duties, therefore, are commonly entrusted to a bailiff, who is seldom sufficiently qualified for them all, and scarcely ever possesses so much attention and frugality, as a prudent and well-informed farmer, whose personal interest is at stake, and who himself manages all his transactions. Though a landed proprietor, therefore, may have acquired sufficient practical knowledge of husbandry, to superintend the management of a farm; yet his other pursuits preclude him from paying such attention to those inferior objects, without which, it is impossible that he should farm to advantage, upon a great scale. Hence a species of farming arises, which is justly denominated *profuse agriculture*, founded on unlimited expense in tillage and manuring; by which, perhaps, double crops are obtained, but are raised at triple cost. Thus, with delusive hopes of profit, many are betrayed into real, though unexpected losses. It is well known indeed, that gentlemen cultivators, after having pursued the profession of husbandry for some years, with much ardour, have frequently relinquished it with chagrin ([166].) Where their farming, however, is carried on with economy, and in moderation, it is of much use, as it keeps up a spirit of experiment in cultivation, and in particular, tends to promote the improvement of stock ([167]).

4. It is next proper to observe, that since the attention of the public has been so much directed to agricultural pur-

suits, many respectable proprietors of land ([168]) have cultivated extensive tracts of country, with the view of trying useful experiments, and disseminating a knowledge of agriculture in their respective neighbourhoods. Nothing can be more laudable than such pursuits. The spirit of improvement which they have thus excited, and the important facts which they have established, must be in the highest degree gratifying to themselves, and useful to their country ([169]).

5. Some landlords, in remote and unimproved districts, convinced that example, and not precept, can alone dispel ignorance, and remove prejudice in rural arts and practices ([170]), have resolved to take a farm into their own hands, with a view of showing an example of correct husbandry to their tenantry; and they look for profit, not from the produce of the farm they occupy, but from the general improvement of their estate ([171]). In other cases, improvements have been carried on by proprietors on a still greater scale. When their estates have been in bad order, the farms ill arranged in regard to extent, figure and boundaries, and the farmers dispirited, poor, and unskilled in agriculture, they have taken a considerable tract of country into their own hands, and, after improving it, have let it to enterprising and skilful farmers. They have then removed their servants, cattle, and implements of husbandry, to another part of the estate, and after treating this in the same manner, they have proceeded to others, as far as circumstances rendered it expedient ([172]).

It is well known, however, that proprietors have in general derived the greatest profit from farms, which they have only partially improved. Indeed it seldom happens, that a landed proprietor can thoroughly improve a farm, without incurring much unnecessary expense; whereas, when a foundation has once been laid, a judicious farmer, with more attention and economy, can accomplish the same, or nearly as much improvement, on far more moderate terms ([173]). Nor, in economical agriculture, is any practice worthy of attention, in which the expense incurred, will not be repaid with a fair profit ([174]).

On this subject it has been justly remarked, that landlords, have in general full scope for the exercise of their abilities, in the improvement and management of their estates, and must derive the greatest pleasure from the faithful discharge of that trust, which Providence has reposed in them; but should high rank, or superior abilities, *impose public duties* *on the proprietor,* which divert his attention from these subjects, the appointment of an agent, equally qualified and inclined to superintend them, is an indispensable obligation which he owes to himself, and a debt due to the public.

2. *Farmers occupying Land.*

In former times, the connexion between a landlord and his tenants, was of a military character. The proprietor of an estate was himself a warrior; and those who possessed land under him, were his soldiers, who were bound to military service, and who paid him hardly any rent in money, but only some personal services, and a moderate quantity of some articles in kind, for the maintenance of his family.

When the feudal system was abolished, the landlord, at first, still considered himself as the patron of those who were placed under him. The rents continued low; the occupiers of the estate tacitly claimed, from generation to generation, under the name of "Kindly Tenants," a sort of patrimonial interest in their respective possessions ([175]); and as they paid very inadequate rents, and had no permanent security in their possessions, nothing could exceed their indolence, their ignorance, and of course the poverty of their condition ([176]).

The connexion between the two classes, is now of a description totally different. The landlord considers himself as the owner of an estate, of which he must make the most that he can, for the benefit of himself and family. He lets it for a certain number of years, to persons possessed of skill, integrity, industry and capital, under the obligation of paying him annually, a specific share of the produce, converted into money, besides being bound, if not to improve the value of the property, at least to preserve it undeteriorated during the currency of the lease. The contract becomes of course more of a mercenary nature, without, however, totally destroying ties of a more pleasing nature; for the landlord, on the one hand, must feel himself deeply interested in the success of his tenant, on which his own income and prosperity materially depend; while the tenant, on the other, looks up to his landlord, as a friend, whose interests are necessarily interwoven with his own, and who will naturally be inclined, to give an industrious and improving tenant a preference, when the farm is to be relet.

Under this system, it is essential both for the landlord and tenant, that the connexion between them should be established on just and liberal principles, so as to induce men of knowledge, enterprise, and capital, to devote their attention to the art of husbandry. This can be expected only where leases are granted. These furnish the most beneficial species of encouragement to agricultural improvement; indeed, if any great exertions are necessary, they are not to be attempted without that security ([177]). Where a proprietor, therefore, does not incline to occupy his land himself, he naturally resolves to surrender the temporary possession of it to others, under such conditions as may be mutually advantageous.

A lease, indeed, is properly a contract, founded on equitable principles, between two men for their mutual advantage. The one possesses an absolute right in the property of a certain tract of land and its produce, the other purchases the temporary privilege of appropriating the produce of that land to himself, at a certain stipulated price. The proprietor of an estate, may thus be considered as in the possession of a certain fixed capital in land, which is capable of producing, when duly cultivated, a certain annual value. The cultivator of the soil, on the other hand, possesses a moveable capital, consisting of the necessary funds for stocking a farm, his knowledge in the art of agriculture, and his industry. Thus situated, the parties, like other men who wish to enter into a joint concern, are induced, by the prospect of mutual advantage, to agree to unite their capitals, for the purpose of assisting nature in producing human subsistence; and their respective interests, having been mutually considered, their agreement constitutes the terms, or specific articles of the lease. On this plain principle depends the connexion between landlord and tenant. The capital invested by the cultivator, the rent he pays, his skill and labour, the contingencies, and chance of loss that may arise, from the inclemency of the seasons, must all be compensated, by the value of the produce of the soil. Where these principles are fully understood and acted upon, both proprietor and tenant will be placed in the most favourable situation, of which the nature of the transaction admits; but where they are departed from, the interest of the one, or of the other, or perhaps of both, must suffer, in proportion to the degree of aberration from that equitable line, which so distinctly marks their respective rights and obligations ([178]).

In regard to the manner of settling a lease;—the period of entry, and the regulations therewith connected;—the duration of leases;—and the covenants to be inserted in them, as these particulars require more detail than is consistent with the nature of a work restricted to general principles, it is proposed to discuss them in a separate paper, (see Appendix, No. 3.) The form of the lease, and the stipulations essential for the interests of the two parties, must vary so much, that it is hardly possible to reduce them to one uniform plan.

Sect. IX.—*Rent*.

The price periodically paid by the occupier, to the owner, for the use of his land, is called *rent*. It formerly consisted of a great number of particulars; as personal services, trifling sums in money, and various articles in kind, as grain, lambs, pigs, poultry, &c. In countries unprovided with a sufficient quantity of circulating medium, payments in kind were unavoidable; nothing, however, could be more injudicious, when circulation became more abundant, than such payments. The grain, and other articles of a similar nature, were uniformly of inferior quality; and the exaction of personal services, was of little advantage to the landlord, while it was an oppressive burden on the tenant, obliging him to keep a greater number of men and horses than his own farm required, and often interrupting the most important farming operations. Rent, therefore, in the present more advanced period of society, ought in general to be restricted to money payments ([179]); and the imposing of any burden which has a tendency to impede the industry of the tenant, or to withdraw his attention from the management of the farm, ought to be avoided ([180]).

The amount of rent, in a general point of view, must always depend on a variety of circumstances; as the wealth of the country;—its population;—the price of produce;—the amount of public and other burdens;—the distance from markets;—the means of conveyance;—the competition among farmers;—and other less important considerations:—but the rent of any particular farm must be regulated by,—the nature of the soil;—the duration of the tenure, and the covenants contained in the lease;—the capital to be invested by the farmer in its culture;—and the expenses to which he is liable.

Poor land cannot possibly pay *the same proportion of rent*, according to the amount of its produce, as that which is rich and fertile. The labour of ploughing, harrowing, sowing, &c. when the land is in cultivation, is nearly the same, and yet the produce is greatly inferior, not only in quantity, but in quality. Indeed, where the produce is inconsiderable, or the quality much inferior, the whole, or nearly the whole, may be swallowed up by the expense of labour, and no rent whatever can be afforded, more especially in adverse seasons.

The duration of the tenure must have a considerable effect, in fixing the rent. No farmer can afford to pay the same sum for land on a short, as if he held it on a long lease. The covenants, also, which are in fact a species of rent, must influence the money payments.

Rent must also in some degree depend on the capital invested in the cultivation of the farm. Thus, if a farmer can lay out only L.4 of capital per acre, he may not be able to afford for it a higher rent than 10s. per acre; if he lays out L.7 he may pay 14s.; and with a capital of L.10 per acre, he may be enabled to pay 18s. or 20s. of rent Hence the advantage of wealthy tenants; and hence the justness of the maxim, "That capital in the hands of the tenantry, is of "as much consequence as the quality of the land ([181])."

But though poor tenants, it is said, make poor farms, yet on the other hand, an exuberance of wealth is often productive of indolent farmers. If therefore a landlord wishes his land to be fairly treated, he must not, on the one hand, exact from his tenants an oppressive rent, nor, on the other, let them have their farms at so easy a rate, as to afford them a more than fair opportunity of becoming overgrown and negligent. The former practice deprives them of the means of manuring their land properly, and giving it a fair culture; the latter induces them to intrust the management of their farm to those who will not give it the attention that its importance demands. The ancients, according to their rustic writers, had a great objection to a tenant, who would not live on his farm, and who trusted its culture to a bailiff.

A frequent change of tenantry is also attended with incalculable mischief, and landlords ought to retain upon their estates, those industrious tenants that were bred on or near them. Notwithstanding the covenants of a lease, there are few farmers, who will not be dishonest enough to lightly manure, or *drive*, (as it is termed), the land, by growing restricted crops during the two or three last years of their lease, especially if they know long beforehand, or even suspect, that they are going to be removed from it at its expiration.

Besides, tenants who, with their forefathers, have been wholly brought up under one landlord, or his ancestors, venerate him as a kind of second parent, form a natural attachment to his estate and family, and feel naturally inclined to do him justice.

It is obvious, that all the expenses of a farm must of necessity be defrayed by a sale of the produce, before any provision can be made for rent; and when these charges absorb more than the whole produce, there is nothing left for the payment of the landlord. The increase of the tenant's expenses, taxes, assessments, tithes, law-charges and stamps, as well as losses by bad debts, and otherwise, would have extinguished rent several years ago, if the price of the bushel of corn, and the pound of meat, had not advanced in proportion to the tenant's expenses, and the other burdens to which he is liable. In the present circumstances of the country, high prices for corn and meat, are indispensably necessary to the existence of rent, more especially upon inferior soils ([182]).

The late ingenious Doctor Coventry, drew up estimates of the produce and the rent of arable lands, varying according to the fertility of their soil, aud their climate, or height of situation. The rents stated in the several columns, were understood to be of lands properly divided, inclosed by adequate fences, and in good tenantable condition. The proposed rents, however, were only calculated to refer to lands in ordinary situations, where there was no extraneous supply of putrescent manures, and at such a distance from great towns, as to be little benefited by them, from their either furnishing manure, or favouring the sale of produce.

Upon the subject of rent, it is proposed to consider: 1. What proportion of the produce should be paid to the landlord; 2. Whether a specific sum in money ought to be paid, or whether it should vary according to the price of produce; and, 3. At what periods the rent should be made payable.

1. *Proportion of produce as rent.*—This is a question, that has long been considered as abstruse, mysterious, and very difficult to resolve. Some have supposed, that one-fifth was a reasonable proportion, while others contend for a fourth, or even a third part of the produce of arable land ([183]). But all former calculations on this subject, are rendered fallacious, by the effects of modern improvements. The rent ought certainly to depend upon the amount of the *disposable produce;* and that produce in grain, is greatly augmented, both by a diminution of the consumption on the farm, effected by improved implements ([284]), and a more correct ar-

rangement of labour, as well as a better cultivation of the land in tillage. Hence, while the price of wheat has greatly advanced during the last twenty years, above the average price of the preceding twenty, the rent of land has not only risen, but has increased in a higher proportion. More grain, and that of a better quality, has been produced on the same extent of land, and a greater amount of disposable surplus has gone to market ([185]).

Out of this surplus disposable produce, it is evident, that the rent must be paid. But it is difficult to divide its amount between the landlord and tenant, as so much depends upon the seasons, and on the prices of the different articles which the farm produces. In bad seasons also, every deficiency of produce, in the acres set apart for supporting home population, must be made up from the disposable surplus; nor is it possible to apply the same rules to all situations, soils, and climates, in all the various districts of an extensive country. It may be proper, however, to give some general idea of the proportion of produce paid as rent, 1. In Scotland; and, 2. In England.

1. In Scotland, the following table exhibits what is considered to be a fair proportion, where the land is cultivated.

Table of Rent on Arable Farms.

	Rent per English Acre.
1. Where land produces L.10, 10s. per acre per annum, one-third, or - - -	L.3 10 0
2. Where land produces L.6, 12s. per annum, one-fourth, or - - - - - -	1 13 0
3. Where land produces only L.4, 5s. per acre, one-fifth, or - - - - -	0 17 0 ([186])

In regard to grazing farms, they are let on principles totally different from the arable, namely, according to the quantity of stock they can maintain; and as they are not liable to the same expense of management, both the landlord and the tenant receive larger shares of the produce, than in the case of arable farms.

2. In England, on the other hand, the husbandmen and their landlords are in a kind of partnership, in which the tenant provides all the capital, and undertakes the management of the whole concern; as a remuneration for which, and for the interest of the money he has invested in it, he is allowed, on arable land, equal to what is considered to be one moiety

of the surplus, after defraying the expenses of cultivation, the taxes to which he is liable for the farm he occupies, and every other outgoing ([187]). Hay land requires much less of his attention, and for this he only obtains one-third of the surplus. But the profits of grazing, depending much on superior judgment in buying and selling stock, as well as skill in preventing, or curing their diseases, the grazier is entitled to a share of the surplus, fully equal to that of his landlord ([188]).

It has been contended, *as a general principle*, that as both the expense of cultivating land, and the value of its produce, are infinitely various, a farmer ought to calculate, what profit he can make *on his whole farm*, without entering into details; it being of little consequence to him, whether he pays at the rate of L.10, or 10s. per acre, provided he makes an adequate interest *on the capital invested.* That is certainly a fair criterion on which a tenant may calculate what he ought to offer; but a landlord, in estimating the rent he ought to insist on, must take into his consideration, the produce that his land is capable of yielding, and what proportion of it, or of its value, at a fair average, he has reason to expect, under all the circumstances of the case, which ought not entirely to depend, on the exertions of a timid, or penurious tenant ([189]).

The profits to which a farmer is entitled, have furnished a subject of much dispute. On the one hand, it is contended, that the produce of land, is of such universal and absolute necessity to the existence of mankind, that it is not reasonable it should yield to him who raises it, more than a fair profit ([190]). On the other hand, it is urged, that a farmer is entitled to be fully recompensed for the application of a considerable capital, exposed to the uncertainty of the seasons, when it is managed with economy, and conducted with industry and skill ([191]); and it has also been observed, that it is seldom more money is got by farming, than an adequate interest for the capital invested. This is owing to "*competition*," the articles produced, being in numberless hands, who must bring them to market; and "*necessity*," the goods of the farmer, being in general of a perishable nature, on the sale of which he depends, for the payments he has to make, and the subsistence of his family.

To prove how moderate the profits of farming in general are, it appears from the most careful inquiries, that *on arable farms* they rarely exceed from ten to fifteen per cent. on the capital invested ([192]), which is little enough, considering that few employments are more subject to casualties than farming, or require more uniform attention. These profits, however, varied much during the late war, and since its termination.

For thirty years prior to 1815, the rise in the prices of farm produce, was so uniform and so great, that every farmer who held a lease on ordinary terms, and of the usual endurance, realised great profits, and if he conducted himself with propriety, became rich. Fifteen or twenty per cent. was held to be a very moderate profit in these times; and many reaped double or triple that amount. But a fatal reverse has been felt since 1815, and more than the one-half of the stock or capital, then held by farmers, has, on an average, been wrested from them; though, in many instances, considerable abatements of rent have been given by a number of proprietors.

In grazing farms the case is different, as they are attended with less expense of labour, and produce articles of a more luxurious description, for which a higher price is given; and as these farms are generally let on very short leases, the rents are better adapted to existing circumstances, than they can be on arable farms, where longer terms are usual. Hence, in such farms, fifteen per cent. and upwards, is not unusual ([193]). Besides, the grazier is more of a merchant than the mere arable farmer; is frequently buying as well as selling stock, and sometimes he makes money by judicious speculations, though occasionally, from a sudden fall of stock, his losses are likewise considerable. The grazier who breeds superior stock, and thence incurs great expense, is certainly well entitled to more than common profit, for his skill and attention.

It has been observed, however, that a farmer seldom makes much money, unless he is most advantageously situated in the neighbourhood of a great town, or unites with farming, some other profitable employment. But those who have capital and ability, adequate to the management of more than one concern, merit to be amply rewarded for their superior skill and industry.

2. *Mode of paying rents.*—In regard to the mode in which rent should be paid, it is proper to consider, whether the whole, or, at least, part of the rent, ought not to depend upon the price of grain, not for the season, but on an average of a certain number of years, preceding that for which the rent is due. By this plan, neither the landlord, nor the tenant, can suffer from the fluctuating price of grain ([194]); whereas, without some such arrangement, the tenant on the one hand, cannot make a fair offer of rent, lest the price of grain should fall too low; nor on the other hand, can the landlord grant a lease of considerable endurance, lest the price of grain should, in the progress of time, rise much higher. It seems therefore to be for the interest of both parties, that, on arable farms, a part of the

rent should be payable in money, and part in corn, not in kind, but in money, according to the average value of a number of years. This plan is enforced by law, to the extent of one-third, in college leases; and thus an income is secured, in some degree proportioned to the value of money.

This mode, however, is not without its difficulties. The amount of rent, for improvable, and well-cultivated farms, does not depend so much on the price of grain, as is commonly imagined. A large proportion of such farms, usually produce green crops, the value of which depends upon the prices of beef, mutton, and wool, and not on that of grain. Various circumstances also may arise, which may reduce the price of particular sorts of grain below its usual level, (for example, barley, when the distilleries are stopped); or may raise it disproportionably much higher, in case a large proportion of the wheat crop should be destroyed by rust or mildew ([195]). But if the proposed payment, by the conversion of corn into money, be extended to the various sorts of grain usually cultivated in the district, *and be restricted to one-half of the rent*, it does not seem liable to any material difficulty. If the payment also, depends on the average of seven or more years, the main objection to a corn rent, that the farmer is often liable to pay the most, when he is the least able to do it, is removed. On the same principles, the rent of sheep farms, ought to be at least partly regulated by the price of wool, and of dairy farms, by the prices of cheese and butter.

3. *Periods of payment.*—These ought to be made so convenient to the tenant, that he may not be under the necessity of selling the produce of his farm to disadvantage, for the sake of ready money; nor should he be compelled to pay his rent out of his capital, for that would cripple all his future exertions. The periods should vary according to the nature of the occupation, and the time when the tenantcy commenced. It is advisable, however, to have the rent payable at two periods of the year, in order to divide the burden of the payment, and that the tenant may not have any money unemployed, which too often leads to waste, and unnecessary expenses.

On the whole, the most successful farmers are those, who embark a capital sufficiently large in their undertaking;—who feel it their duty to watch over that capital with unceasing care, and to add to it whenever it is practicable;—and who have agreed to pay a fair, but not a speculative rent for the lands they cultivate ([196]).

Sect. X.—*Parochial, National, and Miscellaneous Burdens.*

Besides the rent paid to the landlord, the farmers in England and Scotland, are subjected to the payment of various taxes, some of them imposed for local purposes, and others for the general expenses of the state. The real amount of such burdens, every careful tenant ought accurately to know, before he bargains for his lease (197). They may be classed under the following heads: 1. Parochial; 2. National; and, 3. Miscellaneous.

1. *Parochial Burdens.*

These are, 1. For the support of the clergyman; 2. For the maintenance of the poor; and, 3. In Scotland, for providing a parochial schoolmaster.

1. The mode of supporting the clergy in England (198), by paying them a tenth part of the produce of the land in kind, was established in the Christian world, when the revenue of the crown, and the rents of the proprietor, were paid in the same manner. But as the two latter are now commuted, no good reason can be assigned, why the former should not follow the same rule. It is certainly highly expedient for the public interest, that an ecclesiastical establishment should be maintained, and amply provided for, in proportion to the opulence of the country. It is not the total amount that is in general objected to, but the mode of payment, which is considered highly injurious to agriculture, and a check to exertion. It is a great bar to improvement, because a spirited farmer, one more enlightened or more industrious than his neighbours, would pay more tithes, in consequence of his labour and outlay, while his receiving more profit would be a matter of great uncertainty; for though the produce might be more, the expense would be greater. Nothing can be more obnoxious than a law, by which, when a person expends a large sum, either in reclaiming wastes, or augmenting the fertility of land already cultivated, he should be under the necessity of yielding up, one-tenth of its increased produce to a person, who has been liable to no share of the expense,—who has run none of the risk,—and who has sustained none of the labour attending the improvement (199).

Should the cultivation of corn become more operose, and require to be carried on with greater care, attention, and consequent expense, the burden of tithes will be still more severely felt (200). At present, great loss is experienced, when they are exacted in kind, and conveyed, with much additional trouble and expense, not to the barns of the occupier, but to those of the parson (201). A commutation of tithe (202), therefore, instead of its being exacted in kind, would be one of the greatest benefits that could be conferred on agriculture; and there is not the least difficulty in effecting it, by giving to the tithe-owner, either a proportion of the land, or by converting the tithe into a perpetual corn rent. Both these plans have been adopted in a variety of cases, by local acts in England, and they ought now to be enforced as a general system. Others recommend giving a proportion of the rent, (say 3s. or 4s. in the pound), to the tithe-owner; which they are inclined to consider, the most likely plan to obviate every difficulty. It would at least put an end to any uncertainty as to the amount of the demand (203).

2. An assessment for the maintenance of the poor, is another parochial burden, which is annually increasing, and which, if not speedily regulated, upon proper principles, will inevitably absorb a very large proportion of rent in England (204). During infancy, in sickness, and in old age, assistance may be necessary; but, as Malthus justly observes, the poor-laws hold out support to the vicious and idle, at the expense of the prudent and industrious. These payments also, destroy the spirit of independence, and those ideas of honest pride, which stimulate a man, to use his utmost exertions, in support of himself and his family (205); and on its present footing, the boon is administered by the parish officers, with *caution* and *reluctance*, and received by the poor with *dissatisfaction* and *ingratitude* (206). The payment of the poor-rates by the tenants, is attempted to be justified on two accounts: 1. With a view of guarding against unnecessary waste of money, in the temporary relief of the poor, which farmers are more likely to resist than landlords, who mostly reside at a distance; and, 2. To prevent new burdens being brought on parishes, by the hiring of yearly instead of weekly labourers, and thereby settling them, and their future families on the parish (207).

In Scotland, the poor are, in general, maintained by voluntary contributions (208); but when these are not found to be sufficient, the proprietors of the parish, with the clergyman and vestry, or *kirk-session*, are directed to make a list of the indigent persons in the parish, and then to impose an assessment for their relief; one-half to be paid by the proprietors, and the other half by the tenantry. Thus, in general, the people who pay the poor-rates, are both the judges of the indigence of those who claim charity, and the imposers of the assessment for their relief; and this, no doubt, is the best guard that could well be devised, against either an exorbitant assessment, or a prodigal distribution [209].

3. The system adopted in Scotland, by which there is a schoolmaster appointed in every parish, one-half of whose salary is paid by the farmer, is certainly a wise regulation, and becoming an enlightened nation. Why should not every individual in a country, be enabled to read and write, and to understand arithmetic? The acquisition of these essential branches of education opens his mind, improves his morals, and fits him for being a better and more useful member of society; and the means of acquiring them, ought not to depend on the charitable disposition of reluctant contributors, but ought to be secured, to the poorest individual, by the municipal law of the land [210].

2. *National Burdens.*

The national burdens in general, as the duties on houses and windows, and other assessed taxes; or assessments for the support of militia-men's wives and families, for the conveyance of vagrants, or the prosecution of felons, do not fall heavier upon the farmer, than upon other classes of the community. But there was one impost which was severely felt by the arable farmer, while it continued, namely, the tax on horses employed in husbandry. The inequality of that tax was strongly objected to; for lands, when pastured, and necessarily subject to the least expense, paid no part of it. The burden consequently fell exclusively on lands in tillage, which, as a necessary consequence, prevented the British farmer from raising the productions of arable land, as cheaply as the foreign cultivator.

3. *Miscellaneous Burdens.*

There are likewise various miscellaneous burdens affecting the farmer, as statute assessments for bridges, which are of such public utility, that moderate rates for their maintenance, properly applied, cannot be objected to;—statute labour on the highways, for keeping them in good condition, which is a matter of general interest;—constable dues, which are seldom of much moment;—charges of the churchwardens, including the repairs of the church;—and, in some populous parishes, a burial-ground-tax. All these are paid by the occupiers. In some places also, there is a sewer's tax, chargeable on the landlords, where it is not otherwise settled by express contract [211]. Adstriction to mills, however, is the severest burden, where it exists; for not only is the expense of grinding, double or treble what ought to be exacted, but the farmer is bound, to carry his grain, to be manufactured by a person, on whose skill or honesty he cannot always place dependence [212]. Fortunately, the proprietors of mills in Scotland, can be compelled to have their mill-dues valued by a jury, and converted into an annual payment in money.

Whether the public burdens should be paid by the proprietor or the farmer, is a question of considerable importance. When paid by the latter, it is attended with this advantage, that the landlord has only to calculate on a real, and not an ideal income, and he limits his expense accordingly.

The vexations to which farmers in England are subjected, from various uncertain burdens, operate as a premium to Scottish agriculture. It is ingeniously and justly remarked, that physical circumstances are much more favourable to agriculture in England, than in her sister country; but these advantages are counteracted, by the accumulation of moral evils, which might be removed, if the Legislature were to bestow, on matters connected with the internal improvement of the country, and the means for promoting it, a portion of that attention, which it so frequently gives to the amelioration or improvement of our foreign possessions [213].

Concluding Observations.

Besides these, a variety of miscellaneous particulars require consideration, before a prudent farmer will finally resolve to undertake the cultivation of a farm; as, 1. The nature of the property on which the farm is situated; in particular, whether the estate is entailed, and to what extent the possessor of the estate is authorised to grant a lease [214]. 2. The character of the landlord, and in case of his decease, that of his family, and those whom they are likely to consult. 3. The real condition of the farm in regard to the inclosure, drainage, building, &c.; the crops it has usually produced, and the manner in which it has been managed some years preceding. 4. The general state of the district, in regard to the price of labour, and the expense of living; the character of its inhabitants, in particular, of the neighbouring farmers and labourers, and whether they are likely to promote, or to discourage a spirit of improvement.

It is evident, that in hardly any one instance, can all the circumstances above enumerated be favourably combined. But the active and intelligent farmer, will not be discouraged by the obstacles which he may have to surmount; but will strenuously endeavour, by exertion, industry, and perseverance, to overcome the difficulties that must unavoidably be encountered.

CHAP. II.

ON THE MOST ESSENTIAL MEANS FOR CARRYING ON THE IMPROVEMENT AND CULTIVATION OF A FARM.

When a farmer enters on the occupation of any extent of land, a variety of most important objects must necessarily engage his attention; and the following are peculiarly essential, as furnishing the most likely means of promoting his success: 1. The judicious expenditure of an adequate capital, in stocking the farm; 2. The keeping regular accounts, as the only sure foundation of economical culture; 3. The formation of a skilful arrangement of agricultural labour and domestic management; 4. The hiring a proper number of trusty farm servants; 5. The procuring skilful day-labourers when required for occasional purposes; 6. The purchase and maintenance of live stock best adapted for his farm; 7. The acquisition of the most suitable implements of husbandry; 8. The erection of buildings calculated for the objects to be pursued; 9. A command of water; 10. A division of his land, into fields of a proper size and shape; and 11. The construction of good private roads of communication, that easy access to every part of his farm may be secured. When all these particulars are satisfactorily arranged, he may then proceed, with spirit and energy, to the improvement and cultivation of his farm.

Sect. I.—*Capital.*

It is indispensable for the success of every undertaking, whether in farming, or any other branch of industry, that a sufficient capital to carry it on, should be at command. When there is any deficiency in that important particular, the farmer cannot derive an adequate profit from his exertions, as he would necessarily be frequently obliged to dispose of his crops or stock, for less than their value, to procure ready money; and it would restrain him from making advantageous purchases, when even the most favourable opportunities should occur ([1]). An industrious, frugal, and intelligent farmer, who is punctual in his payments, and hence in good credit, will strive with many difficulties, and get on with less money, than a man of a different character. But if he has not sufficient live stock to work his lands in the best manner, as well as to raise the necessary quantity of manure;—nor money to purchase the articles required for the farm, he must, under ordinary circumstances, live in a state of penury and hard labour; and the first unfavourable season, or other incidental misfortune, will probably sink him under the weight of his accumulated burdens ([2]). Farmers are too generally disposed, to engage in larger farms than they have capital to stock and cultivate. This is a great error; for it makes many a person poor upon a large farm, who might live in comfort and acquire property, upon one of less extent ([3]). No tenant can be secure without a surplus at command, not only for defraying the common expenses of labour, but those which may happen from any unexpected circumstance ([4]). When a farmer, on the other hand, farms within his capital, he is enabled to embrace every favourable opportunity of buying, when prices are low, and of selling when they are high ([5]).

The amount of capital required, must depend upon a variety of circumstances; as, 1. Whether it is necessary for the farmer to expend any sum in the erection, or in the repair of his farm-house and offices; 2. What sum an incoming tenant has to pay to his predecessor, for the straw of the crop, the dung left upon the farm, and other articles of a similar nature; 3. The condition of the farm at the commencement of the lease, and whether any sums must be laid out in drainage, inclosure, irrigation, levelling ridges, &c.; 4. Whether it is necessary to purchase lime, or other extraneous manures, and to what extent; 5. On the period of entry, and the time at which the rent becomes payable, as this is sometimes exacted, before there is any return from the lands, out of the actual produce of which it ought to be paid; and, lastly, on its being, 1. A grazing; or 2. An arable farm; or, 3. A mixture of both ([6]).

1. *Grazing farms.*—In pasture districts, the common mode of estimating the capital that may be necessary, is according to the amount of the rent; and it is calculated, that in ordinary pastures, every farmer ought to have at his command, from three to five times the rent he has agreed to pay. But in the more fertile grazing districts, carrying stock worth from L.20 to L.30, and even upwards, *per* acre, (as is the case in many parts of England), five rents are evidently insufficient. When prices are high, ten rents will frequently be required, by those who breed superior stock, and enter with spirit, into that new field of speculation and enterprise ([7]).

2. *Arable farms.*—The capital required by an arable farmer, varies according to circumstances, from L.5 to L.10, or even L.15 *per* English acre ([8]). An ignorant, timid, and penu-

rious farmer, lays out the least sum he can possibly contrive; and consequently he obtains the smallest produce or profit from his farm. These, however, will always increase, when accompanied by spirit and industry, in proportion to the capital employed, if judiciously expended. At the same time, attention and economy cannot be dispensed with. It is ill-judged to purchase a horse at forty guineas, if one worth thirty can execute the labour of the farm; or to lay out sums unnecessarily upon expensive harness, loaded with useless ornaments ([9]). Prudent farmers also, who have not a large capital at command, when they commence business, often purchase some horses still fit for labour, though past their prime, and some breeding mares, or colts; and in five or six years, they are fully supplied with good stock, and can sometimes sell their old horses without much loss. In every case, such shifts must be resorted to, where there is any deficiency of capital.

3. *A mixture of arable and grass farming.*—This, on the whole, is the most profitable method of farming. Independently of the advantages to be derived from the alternate husbandry, so favourable to the improvement of the soil, the chances of profit are much more numerous from a varied system, than where one object is exclusively followed. Where this mixed mode of farming is practised, the farmer will frequently rely on the purchase of lean stock, instead of breeding his own; and derives great advantage, from the quickness with which capital thus employed is returned. In that case, however, the profit must greatly depend upon judicious selection.

It is not necessary to enter into any detailed estimates, of the capital required for stocking cultivated farms, as they have been already explained in former publications ([10]). In general it may be said, that to stock a turnip-land arable farm, will require, at this time, L.5 or L.6, and a clay land farm L.7 or L.8 *per* English acre, according to circumstances.

The capital of a farmer is necessarily divided into three branches. The first is partly expended on implements, or stock of a more or less perishable nature, and partly vested in improving the soil; for this the farmer is entitled to a certain annual gain, adequate to return, within a given number of years, the sum thus laid out. The second is employed in defraying the charges of labour, the purchasing of manure, &c. as they occur throughout the year; the whole of which, with the interest, should be replaced by the yearly produce. The third is laid out in permanent improvements, as in draining, inclosing, bringing in waste lands, &c. which it requires a long lease to replace ([11]).

The most satisfactory statement hitherto given, of the profit derived from the expenditure of an adequate capital in arable farming, is that furnished by George Rennie, Esq. of Phantassie, in East Lothian. On a mixed soil of 702 English acres, he states the profits at L.1, 5s. *per* English acre, or about 14 *per cent.* on the capital employed. On this subject, it has been well observed, that unless something commensurate to their skill, capital, and industry, is made by intelligent and industrious farmers, it would injure both the proprietors of land, and the public. Adventurers who possess but little capital, would occupy the farms, deceiving the proprietor, by the offer of higher rents than could be derived from the employment of insufficient capitals. The soil would consequently be inadequately cultivated, and the landlords, as well as the public, would sustain great loss ([12]).

Mr Mondez of Frasnes, near Charleroi, who was considered to be the most intelligent farmer in the Netherlands, drew up, for the Author, an estimate of the capital necessary for the erection of a house, and the cultivation of a farm of 250 acres of arable land, according to the price of the different articles in Flanders, in the year 1815. The cost of the house and outbuildings he estimated at 60,440 French francs, or L.2518 sterling. So large a sum is required for that purpose, owing to the large barns, and other extensive offices required by a farmer in Flanders, where the live-stock, and even the sheep are housed.

In regard to the expense of live-stock, the instruments of husbandry, and other articles necessary for the actual culture of the farm, they would require, in all, 37,476 francs, or L.1544 : 9 : 4 sterling ([13]). The two united amount to a large sum, for a farmer to lay out in a part of the continent, where money is not abundant, where property is not well secured, (being much exposed to foreign invasion), and where the prices of the articles required, are not so high as in England. The capital expended on farms in Flanders is often, however, proportionally lower; but then, Mr Mondez observes, the farmer in general fails, unless he is assisted by an industrious family, or is fortunate in his harvests.

Sect. II.—*Regular Accounts.*

The keeping of regular accounts is not so common among farmers as it ought to be; and in this respect, persons employed in other professions, are much more attentive and correct. Among gentlemen farmers, it is true, there is often a systematic regularity in all their proceedings; and their pages of debtor and creditor, of expense and profit, are as strictly kept, as those of any banking house in the metropolis ([14]). But with the generality of farmers, the case is widely different. It rarely happens, that books are kept by them in a minute and regular manner ([15]); and the accounts of a farmer, occupying even a large estate, and consequently employing a great capital, are seldom deemed of sufficient importance, to merit a share of attention, equal to that bestowed by a tradesman, on a concern of not one-twentieth part of the value ([16]). There is certainly some difficulty in keeping accurate accounts, respecting the profit and loss, of so uncertain and complicated a business, as the one carried on by the farmer, which depends so much on the weather, the state of markets, and other circumstances not under his controul; but the great bulk of farming transactions is settled at the moment, that is to say, the article is delivered, and the money instantly paid; so that little more is necessary, than to record these properly. In regard to the expenses laid out on the farm, an accurate account of them is perfectly practicable, and ought to be regularly attended to by every prudent and industrious occupier ([17]). The Dutch wisely inculcate, "*that no one is ever ruined who keeps good accounts.*"

The advantage to be derived from regular accounts, cannot be doubted ([18]). By examining them, a farmer is enabled to ascertain, the nature and the extent of the expense he has incurred, in the various operations of agriculture; and to discover, what particular measures, or what general system, may contribute to profit, or occasion loss ([19]). The principle of *economy*, may thus be introduced into the management of a farm; and a diminution in the expense may be effected, which is every day becoming of greater importance, as it bears a higher proportion to the produce of the farm ([20]).

In order to facilitate the adoption of so useful a plan, as the keeping of regular accounts, it would be of use, that not only memorandum books, for the transactions of the day, but account books were published, properly arranged, and divided into columns, containing every head, which experience in the business of farming may suggest, together with a broader column for general observations. The accounts of gentlemen farmers, or of the bailiffs they employ, cannot be too minute ([21]); but in regard to common farmers, the great objects are, to have them short and distinct. Models of such accounts may be purchased at a trifling expense.

It is proper to add, that to record pecuniary transactions, is not the only object to be attended to in the accounts of a farmer. It is necessary to have an annual account of the live-stock, and of their value at the time;—of the quantity of hay unconsumed;—of the grain in store, or in the stack-yard;—and of the implements and other articles in which the capital is invested. An account, detailing the expense and return of each field, according to its productive contents, is likewise essential, without which, it is impossible to calculate the advantage of different rotations; the most beneficial mode of managing the farm, or the improvements of which it is susceptible ([22]).

It would also be an important desideratum, to be possessed of a variety of calculations adapted to various qualities of soil, and the several rotations and modes of management for which they are respectively best calculated. Practical men are alone qualified to prepare such statements, which cannot be confidently relied on, unless great accuracy, and sound professional knowledge have been applied in preparing them.

Sect. III.—*Arrangement of Agricultural Labour, and Domestic Expenditure.*

To conduct an extensive farm well, is not a matter of trivial moment, or to the management of which every one is competent. Much may be effected by capital, skill, and industry; but even these will not always ensure success, without judicious arrangement. With it, a farm furnishes an uninterrupted succession of useful labour, during all the seasons of the year; and as the labouring persons and cattle, are regularly employed, at such works as are most likely to be profitable, the utmost is made of the farm, that circumstances will admit of. Under such a system, it is hardly to be credited, how little time is lost, either of the men or horses, in the course of a whole year. This is a great object; for each horse may be estimated at three shillings per day, and each man at two shillings. Every day, therefore, in which a man and horse are unemployed, occasions the loss of at least five shillings to the husbandman.

As the foundation of a proper arrangement, it is necessary to have a plan of the farm, or at least a list of the fields or parcels of land into which it is divided, describing their productive extent ([23]),—the quality of the soil,—the preceding crops,—the cultivation given to each,—and the species and quantity of manure they have severally received. The future treatment of each field, for a succession of years, may then be resolved on, with more probability of success.

With the assistance of such a statement, every autumn, an arrangement of crops for the ensuing year ought to be made out; the fields or pieces of land being classed, according to the purposes for which they are respectively intended. The number of acres allotted for arable land, meadow, or pasture, will thus be ascertained. It will not then be difficult to anticipate, what number of horses and labourers will be required during the season for the fields in culture, nor the live-stock that will be necessary for the pasture land. The works of summer and harvest will likewise be foreseen, and proper hands engaged in due time to perform them ([24]).

As nothing contributes more to facility and satisfaction in business, than to prepare for what must be done, a farmer should have constantly in view, a judicious rotation of crops, according to the nature and quality of his soil, and should arrange the quantity and succession of labour accordingly. Team labour, when frost and bad weather do not intervene, should be arranged for some months; and hand labour, for some weeks, according to the season of the year. "A general memorandum list of business to be done," is therefore essential, that nothing may escape the memory, and that the most requisite work may be brought forward first, if suitable to the state of the weather ([25]). In this way, the labour will go on regularly, and without confusion, while, by a proper attention, either a distribution of labour, or an occasional consolidation of it, may be applied to every part of the farm ([26]).

It is, indeed, in the skilful method of setting men, cattle, and implements properly to work, that the practical farmer, has an advantage, which an experimental theorist never can attain. Excellence in that art alone, frequently makes a difference equal to half the rent of arable land. The same observation holds good, in respect to the grazier's judgment in the selection and proper management of stock. A good farmer should have, it is said, a hundred eyes; for it requires constant activity, advantageously to manage, if the concern is large, so diversified a business.

The following rules, connected with the arrangement, and the successful management of a farm, are particularly to be recommended.

1. The farmer ought to rise early, and see that others do so. In the winter season, breakfast should be taken by candle light, for by this means, an hour is gained, which many farmers indolently lose; though six hours in a week, are nearly equal to the working part of a winter day. This is a material object, where a number of servants are employed. It is also particularly necessary, for farmers to insist on the punctual performance of their orders.

2. The whole farm should be regularly inspected, and not only every field examined, but every beast seen, at least once a-day, either by the occupier, or by some intelligent servant.

3. In a considerable farm, it is of the utmost consequence, to have servants specially appropriated for each of the most important departments of labour; for there is often a great loss of time, where persons are frequently changing their employments. Besides, where the division of labour is introduced, work is executed not only more expeditiously, but also much better, in consequence of the same hands being constantly employed in one particular department. For that purpose, the ploughmen ought never to be employed in manual labour, but regularly kept at work with their horses, when the weather will admit of it.

4. To arrange the operation of ploughing, according to the soils cultivated, is an object of essential importance. On many farms there are fields, which are soon rendered unfit to be ploughed, either by much rain, or by severe drought. In such cases, the prudent farmer, before the wet season commences, should plough such land as is in the greatest danger of being injured by too much wet; and before the dry period of the year sets in, he should till such land as is in the greatest danger of being rendered unfit for ploughing by too much drought. The season between seed-time and winter may be well occupied in ploughing heavy soils, intended to be laid down with beans, oats, barley, and other spring crops, by means of the scarifier. On farms where these rules are attended to, there is always some land in a proper condition to be ploughed; and there is never any necessity, either for delaying the work, or performing it improperly.

5. Every means should be thought of, to diminish labour, or to increase its power. For instance, by proper arrangement, five horses may do as much labour as six perform, according to the usual mode of employing them. One horse may be employed in carting turnips during winter, or in other necessary farm work at other seasons, without the ne-

cessity of reducing the number of ploughs. When driving dung from the farm-yard, three carts may be used, one always filling in the yard, another going to the field, and a third returning; the leading horse of the empty cart ought then to be unyoked, and put to the full one. In the same manner, while one pair of horses are preparing the land for sowing turnips, the other three horses may be employed in carrying the dung to the land, either with two or three carts, as the situation of the ground may happen to require. By extending the same management to other farm operations, a considerable saving of labour may be effected.

6. A farmer ought never to engage in a work, whether of ordinary practice, or of intended improvement, without previously giving it the best consideration of which he is capable, and being satisfied, that it is advisable for him to attempt it; but when begun, he ought to proceed in it with much attention and perseverance, until he has given it a fair trial.

7. It is a main object, in carrying on improvements, not to attempt too much at once; and never to begin a work, without a probability of being able to finish it in due season ([27]).

8. Every farmer should have a book for inserting all those useful hints, which are so frequently occurring in conversation, in books, or in the practical management of a farm. Loose pieces of paper are apt to be mislaid or lost; and when a man wishes to avail himself of them, for examining a subject previously investigated and discussed, he loses more time in searching for the memorandum, than would be sufficient for making half a dozen new ones. But if such matters are entered into a book, and if that book has a table of contents or index, he can always find what he wants, and his knowledge will be in a progressive state of improvement, as he will thus be enabled, to derive advantage, from his former ideas and experience ([28]).

By the adoption of these rules, every farmer will be master of his time, so that every thing required to be done, will be performed at the proper moment, and not delayed till the season and opportunity have been lost. The impediments arising from bad weather, sick servants, or the occasional and necessary absence of the master, will, in that case, be of little consequence, nor embarrass the operations to be carried on; and the occupier will not be prevented, from attending to even the smallest concerns connected with his business, on the aggregate of which his prosperity depends ([29]).

Besides an arrangement for carrying on operations without, a settled plan for the management of the family within, ought not to be neglected. In regard to house-keeping, the safest plan is, not to suffer it to exceed a certain sum weekly, or monthly, stating the value of every article taken from the farm. An annual sum should be allotted for clothing, and the personal expenses of the farmer, his wife, and children, which ought not to be exceeded. The whole allotted expense should be considerably within the probable receipts; and at least one-eighth of the income actually received, should be laid up for contingencies, or expended in *extra* improvements on his farm, if it belongs to the farmer in property, or is held for a term of years ([30]).

Sect. IV.—*Farm Servants.*

The domestic servants employed in carrying on the operations of a farm, are of four descriptions: 1. Bailiffs, overseers, or upper servants; 2. Ploughmen, and inferior male servants; 3. Apprentices for agricultural purposes, where such are to be had; and, 4. Female servants.

1. *Upper servants.*—In all large farms, a bailiff or overseer is necessary, to assist the farmer in carrying on so extensive and complicated a concern, and more especially to act for him in cases of absence or sickness. His business is, to be perpetually on the watch, wherever persons or teams are employed; consequently he must not work himself, which would confine him to one spot. He should be invested with sufficient authority, to compel the other servants and labourers to do their duty; and if he does not hire them, he should at least have the power of dismissing them, subject to the farmer's concurrence. All market transactions, however, and all buying, selling, bargaining, and receiving money, should be done by the master ([31]). If the bailiff be a person of the better sort, and single, many advantages result from his eating at the farmer's table ([32]).

2. *Inferior servants.*—These consist of ploughmen, shepherds, cow-herds, carters, &c. Of these, the ploughmen are the most important, for on them, in a great measure, depends the success of all the crops ([33]).

It is interesting to trace the manner in which these inferior servants have been progressively maintained.

In former times, the servants lived at the same table with their masters, and that is still the practice in those districts where the farms are small [34]. On moderate-sized, and on large farms, they are usually sent to a separate table; but of late a custom has been introduced, of putting them on board-wages. This is a most pernicious practice; which often leads them to the ale-house, corrupts their morals, and injures their health [35]. It is a better plan, with a view of lessening trouble, to board them with the bailiff; but it is still more desirable for the farmer, to have them under his own eye, that he may attend to their religious and moral conduct. He will find much more useful assistance, from the decent and the orderly, than from the idle and the profligate [36].

In consequence of the great advance in the price of provisions, and the difficulty of pleasing persons with the fare prepared for them, (a clamour being often made about a trifling alteration in diet, arising from circumstances perhaps unavoidable), it is the practice, in the vicinity of the metropolis, to diminish the number of domestic servants of every description, and instead of annual servants, to hire day-labourers [37]. But these occasional servants are unsteady, continually wandering from one master to another [38], and are very precarious supports of a tillage farm; for they may quit their service at the most inconvenient time, unless bribed by higher wages; and the farmer may thus lose the benefit of the finest part of the season [39]. Where day-labourers, however, are married, they are more to be depended upon, than unmarried domestic servants, more especially when the labourer has a family, which ties him down to regular industry [40].

The following plan of maintaining the *hinds*, or ploughmen, in the best cultivated districts in Scotland, is found by experience to be greatly superior to any other mode hitherto adopted.

1. Proper houses are built for the farm-servants, contiguous to every farmstead [41]. This gives them an opportunity of settling in life, and greatly tends to promote their future welfare. Thus also the farmer has his people at all times within reach, for carrying on his business.

2. The farm-servants also, when married, receive the greater part of their wages in the produce of the soil, which gives them an interest in the prosperity of the concern in which they are employed. Under this mode of payment, they are certain of being supplied with the necessaries of life, and a rise of prices does not affect them. Whereas, when their wages are paid in money, they are exposed to

many temptations of spending it, which their circumstances can ill afford; and during a rise of prices, they are sometimes reduced to considerable difficulties. From the adoption of an opposite system, habits of sobriety and economy, so conspicuous among the farm-servants in Scotland, and the advantages of which cannot be too highly appreciated, have arisen, and still prevail in these districts.

3. A most important branch of this system is, that almost every married servant has a cow, of a moderate size, kept for him by the farmer, all the year round. This is a boon of great utility to his family. The prospect of enjoying this advantage, has an excellent effect upon the morals of young unmarried servants, who, in general, make it a point, to lay up as much of their yearly wages, as will enable them to purchase a cow, and furniture for a house, when they enter into the married state. These savings, under different circumstances, would most probably have been spent in dissipation.

4. They have also several other perquisites, as a piece of ground for potatoes and flax, (about one-eighth part of an acre for each); liberty to keep a pig, and half a dozen hens; their fuel is carried home to them; they receive a small allowance in money per journey, when sent from home with corn, or for coals or lime; and during the harvest, they are maintained by the farmer, that they may be always at hand.

There are no where to be met with, more active, respectable, and conscientious servants, than those who are kept according to this system. There is hardly an instance of their soliciting relief from the public. They rear numerous families, who are trained to industry, and knowledge in the operations of agriculture, and whose assistance in weeding the crops, &c. is of considerable service to the farmer. They become attached to the farm, take an interest in its prosperity, and seldom think of removing from it (42).

Under this system, every great farm is a species of little colony, of which the farmer is the resident governor. Nor, on the whole, can there be a more gratifying spectacle, than to see a large estate, under the direction of an intelligent landlord, or of an agent competent to the task of managing it to advantage; where the farms are of a proper size; where they are occupied by industrious and skilful tenants, anxious to promote, in consequence of the leases they enjoy, the improvement of the land in their possession; and where the cultivation is carried on by a number of married servants, enjoying a fair competence, and rearing large families sufficient, not only to replace themselves, but also, from their surplus population, to supply the demand, *and even the waste*, of the other industrious classes of the community. Such a system, there is no reason to believe, is brought to a higher degree of prefection, and carried to a greater extent, in the more improved districts of Scotland, than perhaps in any other country in Europe ([43]).

Nothing can be more destructive to the good conduct of hired servants, than the English settlement laws. No prudent farmer will hire a servant for a whole year, or from one year to another, because such a hiring, and consequent service, would entitle the servant to a settlement in the parish, where he has four months resided. Hence farm servants, male and female, are continually changing places; and as they generally have ten days or a fortnight idle time every year, they attend public statutes, as they are called, or hiring markets, where they too frequently spend their money in dissipation, and contract vicious habits, not afterwards to be easily shaken off. Their minds are thus vitiated, good servants are liable to be corrupted by the bad, dissipation is promoted, a cessation of country business is the result for some days, and an awkwardness in it for some time afterwards.

When hiring servants, it would be extremely important, if possible, to get rid of any injurious perquisites, which are often prejudicial to the interests of the master, without being of any advantage to the servant. For instance, in Yorkshire, and in other districts, it is a custom to give farm servants liquor, both morning and evening, whatever is the nature and urgency of the work. Nothing can be more absurd, than permitting a ploughman to stop for half an hour, in a winter day, to drink ale, while his horses are neglected, and shivering with cold ([44]).

3. *Apprentices.*—In several parts of England, particularly in the western counties, a number of farm servants, from the poverty of their parents, lay the basis of their education, and training in husbandry, as parish apprentices. This is founded on the act of the 43d of Elizabeth, but it is not so generally enforced as it ought to be. It is in some cases extended to females, though, when young, they have not strength for many of the common labours of agriculture. But nothing can be urged against boys being so instructed and trained; and such are uniformly found afterwards, to make the best servants, and to be the steadiest and best labourers ([45]).

In Scotland, the plan of apprenticeships, with a view of training servants or labourers to husbandry, is not in practice, but it has been adopted, for the purpose of *educating farmers* for their professional duties. As this seems to be an admirable plan, it is proper to select an example of it. Mr Walker, of Mellendean, an eminent farmer in Roxburghshire, who rents about 2866 acres of arable land, and is distinguished for his skill in agriculture, takes young men under him as apprentices, who, instead of receiving wages, have uniformly paid him ten pounds each. Some of them remain with him two years, but the greater number only one. They eat in his kitchen, where they have always plenty of plain wholesome food. He takes none who are above living in that way, or who will not put their hand to every thing going forward on the farm. He has sometimes been offered ten times the above sum, to take in young gentlemen to eat and associate with his own family, but that he has uniformly declined. These young men have an opportunity of attending to every operation of husbandry, as practised on Mr Walker's farm; and are taught to hold the plough, to sow, to build stacks, &c. He considers them, on the whole, rather profitable, than otherwise, and in some seasons, he finds them particularly useful ([46]).

4. *Female servants.*—These are principally employed in the dairy, in which their skill and diligence are usually in the highest degree praiseworthy. Men often milk the cows, but are not so well calculated as females, for the management of the interior of the dairy house, where so much depends upon attention to cleanliness. Female servants are likewise usefully employed in weeding, in hay-making, at harvest, and in barn-work; and are well entitled to the inferior wages usually given them.

Sect. V.—*Labourers in Husbandry.*

Next in importance to the ploughmen and other hired farm servants, those labourers who are employed in executing the several branches of incidental works upon a farm, are the most valuable to the arable farmer, for without a sufficient supply of such hands, it is impossible for him to carry on the various operations connected with an accurate system of agriculture, either in a perfect manner, or in the proper seasons of the year. It is evident indeed, that the farmer, who depends entirely on his regular farm-servants, whose chief employment is working with horses, must either allow many necessary jobs, that daily occur, to lie over; or if these are performed by the ploughmen, the horses must often be completely idle. Wherever agriculture, therefore, is carried on in any thing like a perfect system, it is always a matter of essential importance for the farmer, to have at his command, a sufficient number of such useful assistants ([47]).

This interesting subject of labourers in husbandry, includes the following particulars: 1. The division of labourers in regard to their possessions; 2. The distinction between day-labourers, and those who work by the piece; 3. Female labourers; 4. The hours of working; 5. The rate of wages; 6. The practice of giving grain, &c. at a cheap rate to labourers; 7. The effect of high wages; and, 8. The advantages of labourers being trained to diligence and activity.

1. *Classes of labourers according to their possessions.*—With a view to the possessions held by labourers, they may be divided into five classes; 1. Those who have a house, but no land; 2. Those who have a right of common; 3. Those who have a garden, or potatoe ground; 4. Those who have some arable land; and, 5. Those who have grass land.

1. Where a labourer has only a cottage to protect him from the inclemency of the weather, he cannot have the same attachment to his dwelling, as if he had some land annexed to it, nor is such a state of the labourer so beneficial to the community. When a labourer has a garden, his children learn to dig and weed, and in that manner some of their time is employed in useful industry. If he is possessed of a cow, they are taught early in life, the necessity of taking care of cattle, and acquire some knowledge of their treatment. But where there is neither a garden to cultivate, nor any cow kept, they are not likely to acquire either industrious or honest habits ([48]).

So strongly were these ideas formerly prevalent, that by the 43d of Elizabeth, no cottage could be built on any waste, without having four acres attached to it. This is now by far too much. If the quantity were reduced to a garden of moderate extent, and if no person could gain a settlement who was not a native, or, if a stranger, who did not fairly rent, in the same parish, for the space of three years, a house and land worth twenty, instead of ten pounds *per annum*, both the poor and the public would thence derive very essential benefits ([49]).

2. In many cases in England, cottagers have no land or

garden, but a right of common. This is of little or no real benefit to them, unless to obtain fuel, the advantage of which is great, and not easily compensated. With a common-right for a cow, or a few sheep, cottagers get an idea of visionary independence, which renders them unfit for the duties of their station ([50]). A labourer of this description is entirely spoiled for industry, and the generality of experienced persons in country matters, must have seen many cases in point. Forest-side cottages in particular, are nurseries of idleness, and seminaries of mischief ([51]).

3. No labourer in the country, can be in a comfortable state without a garden, or at least some ground to cultivate for potatoes. The advantages attending such possessions, shall afterwards be more fully detailed. See Appendix, No. XIII.

4. In some cases, the cottager has good summer pasture, or can hire it in the neighbourhood, and can raise, on arable land in his occupation, turnips and other winter food for a cow. This plan is adapted to countries, where there is a mixture of arable and grazing land; but it is objected to in the more cultivated districts, as taking up too much of the time of the labourer ([52]).

5. The most advantageous system, however, for keeping a cottage cow, is that adopted in grazing districts, where a cottager has a sufficient quantity of inclosed land in grass, to enable him to keep one or two cows both summer and winter, the one half being grazed, and the other mowed, alternately ([53]).

2. *Labourers by the day or the piece.*—On this subject there is a great diversity of opinion.

In favour of working by the great, or piece, it is urged, 1. That when a number of labourers work together *by the day*, much time is lost in idle conversation ([54]); 2. That it is extremely difficult to oversee a number of workmen, and to keep them to their duty ([55]); 3. That working by the piece is the only way, by which an active and diligent labourer can be rewarded for his superior exertion ([56]); 4. That he works with more steadiness and perseverance, when he is satisfied that it is in his power to apply the fruits of his extraordinary labour, to the benefit of his family ([57]); 5. That he likewise works with greater satisfaction to himself, being more independent in regard to time, and less under control ([58]); 6. That the employer has the advantage of having his work executed with dispatch ([59]); and, 7. That the community is benefited, in proportion to the additional quantity of labour thus performed, by the same number of individuals (60).

On the other hand it is contended, that piece-work is not always so durable, nor so well executed; and that such engagements, are a strong inducement to labourers, to overwork themselves, insomuch that those, who make a practice of engaging in task-work, soon wear themselves out by their extra exertions, and become old men at fifty (61).

Contract work, *or by the great*, is however daily gaining ground; and in Middlesex, in particular, a moiety or more, of the whole labour in carrying on farming operations, as mowing, reaping, &c. is done by the piece (62).

The practice of mowing grass by piece-work, is to be preferred on the following grounds: 1. Because by doing more work, fewer hands are required, at a time when they are commonly *much in demand;* and, 2. Because, in consequence of such expedition, the object of securing the hay is much sooner accomplished, which is often of *incalculable importance* (63).

In regard to the corn harvest, it entirely depends upon the season and the climate. When the work is done by the day, the week, or the month, it certainly requires attention, to see that the men work properly; but in harvest, hours are not much considered, and those who are employed in it, when the weather is favourable, work in general without reluctance, with moderate encouragement, as long as it is practicable (64). When the harvesting is carried on by piece-work, the farmer must be equally upon the watch, lest the corn should be cut down in a damp state, or the reaping carelessly executed, or that it should be brought in before it is perfectly dry. Reaping the corn, binding the sheaves, and setting them up to dry, is, however, frequently executed by the acre. The subsequent care of the sheaves, as well as carting them, and making the corn-stacks, is a separate concern, which is generally done by the teams of the farmer, under his own superintendence. When corn is reaped by the method called *bagging*, it is more easily, and readily cut low, than high; for that reason, and for obtaining more straw, as well as placing the land in better condition for the plough, nearly all the corn is so reaped, in the neighbourhood of London (65).

One great objection to piece-work is, that it is often imperfectly done, which occasions disputes between the parties. But this difficulty can, in many cases, be easily obviated. Let a specimen be made at the commencement, and a penalty fixed for any variation from it; or let the contractor be bound to accept of day wages, at a fair rate, after all his exertions, if he is detected in doing injustice to his employer: This has been often acted upon with a happy effect (66). Indeed a proper attention to persons while executing the task, or reducing their hire, if the work is not executed in a proper manner, is an effectual mode of preventing, or punishing imposition (67).

3. *Female labourers.*—Women are very fit for taking a share in the lighter toils of agriculture, such as weeding, hoeing, reaping, hay-making, &c. Multitudes of them are thus employed in the neighbourhood of the metropolis. They are mostly from North Wales, and are distinguished for their industry, and their healthy appearance (68). In many parts of the kingdom also, women are employed in reaping corn, and when trained to it from their infancy, become extremely expert in that operation.

4. *Hours of working.*—Ten hours are the general length of time for a day's work, during spring, summer, and autumn. Farmers, however, are not at all uniform in their hours of working during these periods. Some begin at five o'clock, rest three hours at mid-day, during the more violent heat of the sun, and fill up their day's work by beginning again at one o'clock and ending at six in the evening. Others begin at six, and end at six, allowing half an hour for breakfast and an hour for dinner. But although these be the ordinary hours, both for servants and labourers, during the more busy seasons of the year, yet neither will scruple to work either earlier or later, when occasion requires (69). In the winter months, the hours of labour are from the dawn to dusk, with the allowance of about half an hour at mid-day for dinner.

5. *Rate of wages.*—It is a general principle, that the rate at which labour is paid, must in a great measure depend upon the price of grain. In England, the value of a peck of wheat, and in Scotland, of a peck of oatmeal, (being the principal articles of subsistence of the lower orders of the people in the two countries), were long accounted an equivalent to the daily pay of a labourer. In both countries, however, the price of potatoes has, of late years, had a considerable influence in the rate of labour (70); and in England, the effects of the poor laws, have tended to keep down that rate, below the increased price of provisions, and thus have deranged the natural progress of rural economy. It has been ascertained

that a man, his wife, and two or three children, if wheat is their habitual food, will require ten gallons weekly ([71]). When they live on bread, hard-working people ought to have the best kind, as that will furnish the most nourishment. How then could a labourer and his family exist, upon wages of from 6*s.* to 9*s.* per week, when wheat is from 8*s.* to 10*s.* or 12*s.* per bushel ([72])? The difference is compensated by the poor-rates, a most exceptionable mode of making up the deficiency; for labour would otherwise have found its own level, and the labourer would have obtained the price of a bushel and a half of wheat weekly.

In Scotland, the rate of labour has increased beyond the price of provisions. Prior to 1792, the average price of a peck of oatmeal was 1*s.* 1*d.* and the average price of a day's labour in summer, 1*s.* 1$\frac{1}{8}$*d.* which nearly corresponded with the principle above stated; but the average price of a peck of oatmeal, in 1810, was 1*s.* 3$\frac{3}{4}$*d.* whilst the average price of a day's labour was 1*s.* 10$\frac{1}{2}$*d.* which shews, in a most satisfactory manner, the very great improvement that has taken place, in the lot of the labouring classes, in that part of the united kingdom ([73]).

6. *The practice of giving labourers grain, &c. at a cheap rate.*—In order to compensate for the low rate of labour, compared with the increased price of provisions, his late Majesty, (George III.) who carried on farming operations to a considerable extent, adopted the plan of allowing his labourers flour at a fixed price, whatever wheat might sell for. This benevolent system has been imitated by several gentlemen farmers, some of whom have allowed bread, and others a daily quantity of milk, at moderate prices ([74]). The same system is general in several of the western counties, as in Dorset, Devon, and Cornwall, where the labourers have a standing supply of bread-corn;—of wheat at 6*s.* and of barley at 3*s.* per bushel ([75]).

7. *Effects of high wages.*—In the wages of labour, as well as in every thing else, moderation is desirable. It is remarked, that high wages have a tendency to throw labourers out of employment, as farmers in general, and even small proprietors, are unable to give such wages; hence they are obliged to carry on their work with fewer hands, or to postpone improvements, which otherwise they would have undertaken. Nor is that all; the labourers themselves suffer by it, and so does the public. In the fens of Lincolnshire, wages have risen in harvest time, from 3*s.* 6*d.* to 7*s.*

nay to 10*s.* 6*d.* per day; every day's hiring, taking place at a certain spot, where masters, whose work required haste, outbid each other, and thus raised the wages to that exorbitant height. The consequence was, that the labourers got drunk, would not work above four days out of the six, spent their money, hurt their constitutions, and contracted indolent and vicious habits, so that their labour was lost to the community, for at least one-third part of the time, at a most important crisis ([76]). The farmers were thence compelled to look for aid to other districts, and even to induce the natives of Ireland to assist them in getting in their harvests.

8. *On training labourers to activity and diligence.*—It is of great importance, to train labourers employed in agriculture, to activity and diligence. In some districts, they are proverbial for the slowness of their step, which they teach their horses, whereas, these animals, if accustomed to it, would move, with as much ease to themselves, in a quick, as in a slow pace. Hence their ploughs seldom go above two miles in an hour, and sometimes even less; whereas where the soil is light and sandy, they might go at the rate of three miles and a half. Farmers are greater sufferers than they imagine, by this habitual indolence of their workmen, which extends, from the plough, to all their other employments ([77]), for it makes a very important difference in the expense of labour. Where the land however is stiff, and deep ploughing is necessary, the operation ought not to be too much hurried.

Sect. VI.—*Live Stock.*

Under the general term *live stock*, are comprehended, the various sorts of domesticated animals, which are employed by man as instruments, for assisting him in labour, or in converting to his use, those productions of the soil, which are not immediately applicable to his wants, in their natural state. Bakewell has very properly described them as machines, for converting herbage, and other food for animals, into money. But money, in fact, is only the sign of wealth, while live stock are real riches.

It may be proper to begin with remarking, that by far the largest proportion of the territory of almost every country, is devoted to the breeding and support of live stock. In early ages, these formed the only criterion of wealth. They became of less consequence when the culture of grain was first introduced; but their importance afterwards, as the instruments of cultivation, as the means of supplying a large proportion of our food, and as furnishing a variety of our most essential accommodations, tends to render this branch of the inquiry peculiarly interesting.

It is impossible, in a work of so condensed a nature as the present, to attempt any minute explanation of the various particulars, connected with the rearing and after management of live stock, for they are still more numerous, than those which belong to the cultivation of the different kinds of soil, or raising the various crops which they produce. The subject, therefore, cannot be minutely discussed; but it is proposed to offer *a few general remarks*, 1. On the most desirable properties of live stock; 2. On the origin of improved breeding, and the principles on which it depends; and, 3. On the proper management of stock intended for consumption; to which shall be added, 4. Some observations on the size, and most economical mode of feeding horses.

To enter fully into details regarding these particulars, would have required a volume of no inconsiderable dimensions (78).

1. *On the most desirable Properties of Live Stock intended for consumption.*

The most desirable properties of stock, intended for the purposes of food, may be considered under the following heads: 1. Size; 2. Form; 3. A tendency to grow; 4. Early maturity; 5. Hardiness and vigour of constitution; 6. Prolific properties; 7. Quality of flesh; 8. A disposition to fatten; 9. Lightness of offal; and, 10. Milking properties. The following observations are the result of much careful inquiry regarding these important particulars.

1. *Size.*—Before the improvements introduced by Bakewell, the value of cattle, sheep and hogs was entirely judged of by their bulk; and if a great size could be obtained, more regard was paid to the price the animal ultimately fetched, than to the cost of its food. Of late, since breeders began to calculate with more precision, small, or moderate-sized animals, have been generally preferred, for the following reasons:

1. Small-sized animals are more easily kept; they thrive on shorter herbage, they collect food where a large animal could hardly exist, and thence are more generally profit-

able ([79]). 2. Their meat is finer grained, produces richer gravy, has often a superior flavour, and is commonly more nicely marbled, or veined with fat, especially when they have been fed for two years ([80]). 3. Large animals are not so well calculated for general consumption, as the moderate sized, particularly in hot weather. 4. Large animals poach pastures more than small ones. 5. They are not so active, require more rest, collect their food with more labour, and will only consume the nicer, and more delicate sorts of plants. 6. Small cows, of the true dairy breeds, give proportionally more milk than large ones. 7. Small cattle may be fattened solely on grass, of even moderate quality; whereas the large require the richest pastures, or to be stall-fed, the expense of which exhausts the profit of the farmer. 8. It is much easier to procure well-shaped, and kindly-feeding stock of a small size, than of a large one. 9. Small-sized cattle, may be kept by many persons, who cannot afford, either to purchase, or to maintain large ones; and by whom the loss, if any accident should happen to them, can be more easily borne. 10. The small-sized sell better; for a butcher, from a conviction that, in proportion to their respective dimensions, there is a greater superficies of valuable parts in a small, than in a large animal, will give more money for two oxen of twelve stone each per quarter, than for one of twenty-four stone.

In favour of the large-sized, it is on the other hand contended, 1. That without debating whether from their birth, till they are slaughtered, the large or the small one eats most for its size, yet on the whole, the large one will pay the grazier or farmer who fattens him, as well for its food. 2. That though some large oxen are coarse grained, yet, where attention is paid to the breed, (as is the case with the Herefordshire), the large ox is as delicate food as the small one. 3. That if the small-sized are better calculated for the consumption of private families, of villages, or of small towns, yet that large cattle are fitter for the markets of great towns, and in particular of the metropolis. 4. That were the flesh of the small-sized ox superior, when fresh, yet the meat of the large-sized is unquestionably more calculated for salting, a most essential object in a maritime and commercial country, for the thicker the beef, the better it will retain its juices when salted, and the fitter it is for long voyages. 5. That the hide of the large ox is of very great consequence in various manufactures. 6. That large stock are in general distinguished by a greater quietness of disposition. 7. That where the pastures are good, cattle and sheep will increase in size, without any particular attention on the part of the breeder; large animals are naturally therefore the proper stock for such pastures. 8. That the art of fattening cattle, and even sheep, with oil-cake, being much improved and extended, the advantage of that practice would be of less consequence, unless large oxen were bred, as small oxen can be fattened with grass and turnips, as well as oil-cake: And lastly, That large oxen are better calculated for working than small ones, two large oxen being equal to four small ones in the plough or the cart.

Such are the arguments generally made use of on both sides of the question; from which it appears, that much must depend upon pastures, taste, mode of consumption, markets, &c. and that both sizes have their peculiar advantages. The intelligent breeder, however, (unless his pastures are of a nature peculiarly forcing), will naturally prefer a moderate size, in the stock which he rears.

2. *Form.*—Though it is extremely desirable, to bring the shape of cattle to as much perfection as possible, yet profit and utility ought not to be sacrificed for mere beauty, which may please the eye, but will not fill the pocket ([81]); and which, depending much upon caprice, must be often changing.

In regard to form, the most experienced breeders seem to concur in the following particulars: 1. That the form or shape should be compact, so that no part of the animal should be disproportioned to the other parts; and the whole distinguished by a general fulness and rotundity of shape; 2. That the chest should be broad; for no animal whose chest is narrow, can easily be made fat ([82]); 3. That the carcase should be deep and straight; 4. That the belly should be of a moderate size; for when it is more capacious than common, in young animals, it shews a diseased state, and in older ones, it is considered a proof, that the animal will not return in flesh, in milk, or in labour, the value of the extra quantity of food which it consumes ([83]); 5. That the legs should be short, for the long-limbed individuals of the same family or race are found to be the least hardy, and the most difficult to rear or to fatten; and, 6. That the head, the bones, and other parts of inferior value, should be as small as is consistent with strength, and with the other properties which the animal ought to possess. In animals bred for the shambles, the form must likewise be such, as to contain the greatest possible proportion of the finer, compared to the coarser and less valuable parts of the animal. This, by selection, may be attained; and thus the wishes of the consumer may be gratified. As to the broad loins, and full hips, which are considered as a point of excellence in particular breeds, it is evident, that the old, narrow, and thin make required improvement; but the alteration is now carried to a faulty excess, and often occasions great difficulty and danger in calving ([84]).

The form of animals has fortunately attracted the attention of an eminent surgeon, (Henry Cline, Esq. of London), the substance of whose doctrines is: 1. That the external form is only an indication of the internal structure; 2. That the first object to be attended to is the lungs, for on their size and soundness, the health and strength of an animal principally depend; 3. That the external indications of the size of the lungs, are the form and size of the chest, and its breadth in particular ([85]); 4. That the head should be small, as by this the birth is facilitated;—as it affords other advantages in feeding, &c.—and as it generally indicates that the animal is of a good breed; 5. That the length of the neck should be in proportion to the size of the animal, that it may collect its food with ease; and, 6. That the muscles and tendons should be large, by which an animal is enabled to travel with greater facility.

It was formerly the practice, to estimate the value of animals by the size of their bones. A large bone was considered to be a great merit; and a *fine-boned* animal, always implied great size. It is now known, that this doctrine was carried too far. The strength of an animal does not depend upon the bones, but on the muscles; and when the bones are disproportionably large, it indicates, in Mr Cline's opinion, an imperfection in the organs of nutrition ([86]). Bakewell strongly insisted on the advantage of small bones; and the celebrated John Hunter declared, that small bones were generally attended with corpulence, in all the various subjects he had an opportunity of examining. A small bone, however, being heavier and more substantial, requires as much nourishment as a hollow one, with a larger circumference ([87]).

3. *A tendency to grow.*—Among the qualities for which thorough-bred cattle and sheep are distinguished, that of being *good growers*, is not the least essential. The meaning of which is, that the animal should not only be of a strong and healthy constitution, but should grow speedily to a proper size. As specimens of rapid growth, a steer of three

years old, when well fed, will weigh from 80 to 90 or 100 stone, 14 lb. to the stone; and a two year old Leicester wedder, from 25 to 28 lb. per quarter, immediately after his second fleece is taken from him. Animals having the property *of early growing*, are usually straight in their back and belly; their shoulders well thrown back, and their belly rather light than otherwise. At the same time, a gauntness and paucity of intestines should be guarded against, as a most material defect, indicating a very unthrifty animal. Being *too light of bone*, as it is termed, is also a great fault. A good grower has always middling-sized bones. A bull distinguished for getting good growers, is inestimable; but one whose progeny takes an unnatural or gigantic size, ought to be avoided ([88]).

4. *Early maturity.*—Arriving soon at perfection, not only in point of *growth* or size, but in respect of *fatness*, is a material object for the farmer, as his profit must in a great measure depend upon it. When animals, bred for the carcase merely, become fat at an early age, they not only return sooner the price of their food, with profit to the feeder, but in general also, a greater value for their consumption, than slow-feeding animals ([89]). This desirable property greatly depends on a mild and docile disposition; and as this docility of temper is much owing to the manner in which animals are brought up, attention to accustom them early to be familiar, cannot be too much recommended. A tame breed also has other advantages. It is not so apt to injure fences, or to break into adjacent fields; consequently it is less liable to accidents, and can be reared, supported, and fattened, at less expense. The property of early maturity, in a populous country, where the consumption of meat is great, is extremely beneficial to the public, as it evidently tends to furnish greater supplies to the market; and this propensity to fatten at an early age, is a sure proof, that an animal will fatten speedily at a later period of its life. For that purpose, it is of the utmost importance to feed the animal well, when it is young; for it does not easily recover the injury it sustains, when, in that respect, there is any material deficiency.

5. *Hardiness and vigour of constitution.*—In the wilder and bleaker parts of a country, the possession of a hardy and healthy constitution, is of peculiar importance. Where the surface is barren, and the climate rigorous, it is essential that the stock bred and maintained there, should be able to endure the severities and vicissitudes of the weather, as well

as scarcity or coarseness of food, or any other circumstance in its treatment, that might subject a more delicate breed to injury. In this respect, different kinds of stock greatly vary; and it is a matter of much consequence to select, for different situations, cattle with constitutions suitable to the place where they are to be kept ([90]). It is a popular belief, that dark colours are indications of hardiness. In mountain breeds of cattle, a rough pile is reckoned a desirable property, more especially when they are to be kept out all winter. It enables them to face the storm, instead of shrinking from it ([91]). But without being hardy, when distinguished by the excellence of their shape, cattle may possess "*vigorous constitutions.*" With that advantage they are not subject to various disorders, to which ill-shaped cattle are liable, as having yellow fat ([92]), also being *lyery*, or black-fleshed ([93]), defects so injurious to stock, as to render them unsaleable.

6. *Prolific property.*—By this property is meant, that the females of a breed, shall not only bear more frequently than usual, but shall also occasionally have more than one at a birth. This property runs more strikingly in sub-varieties, or individual families; and though partly owing to something in the habits of animals, and partly to their previous good or bad treatment ([94]), yet, in some degree, seems to depend upon the seasons, some years being more distinguished for twins than others. In breeding, not only the numbers, but the sex of the offspring, in some cases, seems to depend upon the female parent. Two cows produced fourteen females each in fifteen years, *though the bull was changed every year*. It is singular, that when they produced a bull calf, it was in the same year. Under similar circumstances, a great number of males have been produced by the same cow in succession, but not to the same extent ([95]).

7. *Quality of flesh.*—Breeds are likewise distinguished by the quality of their flesh. In some kinds it is coarse, hard, and fibrous;—in others of a finer grain or texture. In some breeds also, the flavour of the meat is superior;—the gravy they produce, instead of being white and insipid, is high coloured, well flavoured, and rich;—and the fat is intermixed among the fibres of the muscles, giving the meat a streaked, or marbled appearance. Breeds whose flesh have these properties, are peculiarly valuable. Hence two animals of nearly the same degree of fatness and weight, and who could be fed at nearly the same expense to the husbandman,

will sell at very different prices, merely from the known character of their meat ([96]).

8. *A disposition to fatten.*—This is a great object in animals destined for the shambles. Some animals possess this property during the whole progress of their lives, while in others, it only takes place at a more advanced period, when they have attained their full growth, and are furnished at the same time with a suitable supply of food. There are in this respect other distinctions: 1. Most sorts of cattle and sheep which have been bred in hilly countries, will become fat on lowland pastures, where the more refined breeds would barely live; and, 2. Some animals take on fat very quickly, when the proper food has been supplied; and some individuals have been found, even in the same breed, which have, in a given time, consumed the least proportional weight, of the same kind of food, and yet have become fat at the quickest rate. Even in the human race, with little food, some will grow immoderately corpulent. It is probably from internal conformation, that this property of rapid fattening is derived ([97]).

The advantages and disadvantages of fattening cattle and sheep, at least to the extent frequently practised at present, are points, that have of late attracted much public attention. But any controversy on that subject, can only arise from want of proper discrimination. Fat meat is unquestionably more nourishing than lean, though, to digest this oily matter, there are required, on account of its difficult solubility, much saliva, a strong stomach, and good bile; consequently none, excepting those who are in the most vigorous state of health, or who are employed in hard labour, can properly digest it ([98]). Though fat meat, however, is unfit for general consumption, yet experiments in the art of fattening animals, are likely to promote useful discoveries; and though, in the course of trying a number of experiments, errors and excesses may be committed, yet, on the whole, advantage may be derived from the knowledge thus to be obtained ([99]). It has been found, that to kill even hogs till they are thoroughly fat, is exceeding bad economy. An ox or cow, though the little flesh it has may be of good quality, yet presents, when lean, little but skin and bone; and if slaughtered in that state, would neither indemnify the owner for the expense of breeding and maintaining it, nor benefit the public. A coarse and heavy fleshed ox, which would require a very long time, and much good food to fatten, may be slaughtered with most advantage, while rather lean. It is not, however, so much the extent of fat, as the want of a sufficient quantity of lean flesh, of which the consumer complains; for it cannot be doubted, that the lean flesh of a fat animal, is superior in quality, and contains more nourishment, than any other meat ([100]).

Here it may be proper to mention that indication of a tendency to fatten, which is technically called *handling well.* The graziers and butchers in various parts of the kingdom, had recourse to the hand, and the feeling of the skin, or cellular membrane, for ascertaining a disposition to fatten ([101]); but since Bakewell directed the public attention so much to breeding, that practice has become more generally known. Handling cannot easily be defined, and can only be learnt by experience. The skin and flesh of cattle, when handled, should feel soft to the touch, somewhat resembling those of a mole, but with a little more resistance to the finger. A soft and mellow skin must be more pliable, and more easily stretched out, to receive any extraordinary quantity of fat and muscle, than a thick or tough one. The rigid-skinned animal, must therefore always be the most difficult to fatten. In a good sheep, the skin is not only soft and mellow, but in some degree elastic. Neither cattle nor sheep can be reckoned good, whatever their shapes may be, *unless they are first-rate handlers* ([102]).

The improved short-horned breed, besides their mellowness of skin, are likewise distinguished by softness and silkiness of hair. Too great a length, however, ought not to be aimed at, since it is not easy, in that case, to preserve a due proportion in the appearance of the animal, without which it cannot be considered perfect ([103]).

9. *Lightness of offal.*—It is also of much importance, that an animal solely bred for the shambles, should have, (consistently with the health of the animal), as little *offal*, or parts of inferior value as possible, and consequently a greater proportion of meat applicable as food for man ([104]).

10. *Milking properties.*—It cannot be doubted, in regard to cattle, that the production of milk, is an object of peculiar importance; and in the more populous districts, must be considered as even indispensable. It is most desirable therefore, to have a breed, which, when young, produces milk in great perfection and abundance, and when they get old, are easily fattened. These advantages are possessed, in an eminent degree, by the Herefordshire, the Ayrshire,

and the short-horned, and it gives these breeds a great pre-eminence over other stock *.

It may be proper to conclude this branch of the subject with observing, that the great perfection of the shape of an animal is, when the dead weight of all the eatable parts approaches the nearest to the weight of the animal when alive. The proportion of dead weight, after being fed for two years in succession, sometimes amounts to three-fourths of the live weight, or as 15 is to 20, but it rarely exceeds that rate †.

II. *On the origin of improved Breeding, and the Principles on which it depends.*

It is not to be wondered at, that the management of our stock should have been defective, when cattle in general were bred by one set of men, fattened or prepared for the market by a second, and killed by a third. Whilst these three occupations continued distinct, with only occasional communications or intercourse with each other, no great improvement could be effected. That division of labour, or separation of professions, so useful in manufactures, was pernicious to this important branch of agriculture, by preventing the principles on which the improvement of our domestic animals depend, from being ascertained ([105]).

A person, however, of strong natural sagacity, (Robert Bakewell of Dishley, in the county of Leicester), though he did not unite, to the extent that his disciple Culley did, the two distinct occupations of breeder and grazier, yet, having acquired great skill in grazing, by which he was enabled to preserve his breeding-stock in the highest possible condition, and having called in to his aid, all the skill and experience which the butcher had acquired, was thus enabled to ascertain the principles, not only of breeding domestic animals, so as to answer the common expectations of the farmer, but also of bringing them to a degree of perfection, of which, before his time, they were scarcely supposed capable; and by directing the public attention in general, and that of the farmer in particular, to the art of breeding, he has in various respects most essentially benefited his country. By his example, that most important system was very generally established,

* This subject shall be fully discussed in a separate paper on the Dairy. See Addenda, No. 1.

† See the comparative statement of the living and dead weight of a Devon ox, Note 104.

of certain breeders directing their whole attention to the rearing of males, and letting them for the season, at such prices as would amply indemnify the breeder for all the care and expense he had bestowed upon them, a practice, which had originally taken place in Lincolnshire, but had never been carried to any great extent till adopted by Bakewell.

The art of improved breeding consists, in making a careful selection of males and females, for the purpose of producing a stock, with fewer defects, and with more valuable properties than their parents; by which their mutual perfections shall be preserved, and their mutual faults corrected ([106]). Its objects, therefore, are, to obviate defects, and to acquire and to perpetuate desirable properties; hence, when a race of animals have possessed, in a great degree, through several generations, the properties which it is our object to obtain, and when any tendency to produce unwished-for properties has been extirpated, their progeny are said to be *well-bred,* they possess what is technically called "*blood,*" and their stock may be confidently relied on ([107]).

It was upon this principle of selection, that Bakewell formed his celebrated stock of sheep, having spared no pains or expense, in obtaining the choicest individuals, from all the best kinds of long or combing woolled sheep, whereever they were to be met with ([108]). Nor did he depend upon such selection alone, for he also spared neither pains nor expense in giving his stock every advantage that could be derived from attention to their food,—protection from any thing that could annoy them,—and shelter from the inclemency of the seasons. After a superior breed, however, has been obtained, and perfected, by putting the best males to the finest females, it is a point that has been much disputed, whether it is proper to raise stock, 1. From the same family; or, 2. From the same race, but of different families; or, 3. From races entirely different.

1. *Breeding from the same family.*—This method is called breeding *in-and-in,* or putting animals of the nearest relationship together ([109]). Though this plan was for some time in fashion, under the sanction of Bakewell's authority, yet experience has now proved, that it cannot be successfully persevered in, and that beyond a certain point of perfection, nature cannot be forced. It may indeed prove beneficial, if not carried too far, in fixing any variety that may be thought valuable ([110]); but on the whole, it is so only in appearance. Under this system, the young animal comes into the world,

on, comparatively, a very small scale. By keeping it fat from the first moment of its existence, it is made to attain a greater size than would naturally have taken place; and its weight in consequence will be very great, in proportion to the size of its bones. Thus a generation or two of animals of an extraordinary form, and saleable at enormous prices, may be obtained; but that does not prove that the practice is eligible, if long persisted in ([111]). On the contrary, if the system be followed up, the stock get tender and delicate, they become bad feeders, require expensive articles of food, and though they retain their shape and beauty, they will decrease in vigour and activity, will become lean and dwarfish, and ultimately incapable of continuing the race. The instances of this are numerous. The celebrated breeder, Prinsep, found, that decrease of size was unavoidable, in spite of all his endeavours to prevent it, by keeping his young stock well ([112]). Sir John S. Sebright tried many experiments by breeding *in-and-in*, with dogs, fowls, and pigeons, and found the breeds uniformly degenerate ([113]). A gentleman who tried the system with pigs, brought them at last into such a state, that the females gave over breeding almost entirely; and when they did breed, their produce was so small and delicate, that they died as soon as they were born. Nay, Mr Knight's experience with plants have fully convinced him, that in the vegetable, as well as in the animal kingdom, the offspring of a male and female, not related, will possess more strength and vigour, than where they are both of the same family ([114]). This proves how unprofitable such connexions are. That is no reason, however, why a breeder may not manage a particular family of animals to great advantage, by shifting or changing, instead of breeding directly from parents to offspring ([115]). Hence the propriety of procuring males, from the flocks and herds of those who have the same, or a similar breed. It has been remarked, that those farmers in general have the worst flocks, who breed from rams produced on their own farms, and that an interchange of males is mutually beneficial ([116]).

With respect to the doctrine, " that when you can no " longer find better males than your own, then by all means " breed from them, for that best can only beget best;" it is ably refuted by an intelligent author, who has devoted much attention to the art of breeding. He observes, that there never did exist an animal, without some defect in constitution, in form, or in some other essential quality; and such defect, however small it may be at first, will increase in every succeeding generation, and at last predominate in such a degree, as to render the breed of little value ([117]). Breeding *in-and-in*, therefore, would only tend to increase, and to perpetuate that defect, which might be eradicated, by a judicious selection, from a different family, in the same race.

2. The breeding from different families, of the same race, is therefore a preferable system. When these have been for some time established in different situations, and have had some slight shades of difference impressed upon them, by the influence of different climates, soils, and treatment, it is found advantageous, to interchange the males, for the purpose of strengthening the excellencies, and remedying the defects of each family. On this principle, the celebrated Culley continued, for many years, to hire his rams from Bakewell, at the very time, that other breeders were paying him a liberal price for the use of his own; and the very same practice is followed by the most skilful breeders at present ([118]).

3. Any attempt at improvement, *by crossing* two distinct breeds or races, one of which possesses the properties which it is wished to obtain, or is free from the defects which it is desirable to remove, requires a degree of judgment and perseverance, to render such a plan successful, as is very rarely to be met with. Indeed, though such crosses may, by great attention, answer at first, it is in general, however, found, that great singularities attend such mixtures; and, in breeding bulls, though some of them may apparently answer, yet their breed is not to be trusted. The first cross between a good short-horned bull, and a good Kyloe cow, will make a good grazing animal; but by proceeding farther, disappointment will ensue, if a regular stock be wanted. If such a cross is to be persevered in, the male should always be of the same breed with the first ([119]).

Crossing with larger males, from another country, is sometimes attempted, with a view of enlarging the size of stock. But such attempts should be made with the greatest caution; for by a mistaken practice, extensively pursued, irreparable mischief may be effected. Where a particular race of animals has continued for centuries, it may be presumed, that their constitution is adapted to the soil and climate. Any attempt, therefore, to increase the size of a native race of animals, without improving their food, by which their size is regulated, is a fruitless effort to counteract the laws of nature. In proportion to their increase of size by crossing, they become worse in form, less hardy, and more liable to disease ([120]). The only satisfactory, and judicious mode, of enlarging the size of any race of animals is, by maintaining better the original stock of the country, more especially during their youth. In every case, where the enlargement of the carcase is the object, the cross breed must be better fed than the native parent. Hence, if a good stock can be otherwise obtained, crossing ought to be avoided; for it produces a species of mongrel; and it is more difficult to get rid of the imperfections thus introduced into a breed, than is commonly imagined ([121]).

The eminent surgeon already alluded to, (Henry Cline, Esq.), is of opinion, that any improvement of form by crossing, must entirely depend, on selecting a well-formed female, larger in size than the usual proportion between females and males ([122]). The fœtus will thus be better nourished, which is so essential to the production of an animal with the most perfect form, abundant nourishment being necessary, from the earliest period of its existence, until its growth is complete. Upon this principle, the breed of English horses have reached their present state of perfection, by crossing them with diminutive stallions, Barbs, and Arabians; and our hogs have been improved, by the use of small Chinese boars. Other experiments on the same principle, have also succeeded. Mr Spearman, a farmer in Northumberland, tried a cross between the Kyloe or Highland bull, and the large short-horned cow; and during the experience of twenty years, found it to answer. The plan recommended by Mr Cline, has likewise been most successfully practised by M. Van de Poes, near the Hague, who has perhaps the finest stock of dairy cows in Holland. The excellence of his breed he entirely attributes to his using none but young bulls, which have not attained their full growth or size, and which he always parts with at three years of age.

The improvement of the fleece depends, however, upon the male; it being proved that, by always using the Merino ram, fleeces, rivalling the Spanish, may be obtained from ewes of British stock, in the course of four or five generations ([123]).

In regard to the period of commencing breeding, a cow in general, should not produce a calf, at an earlier period than three years old. A bull may be first used at fourteen or eighteen months. He then shews most vigour, and more energy may be expected in his produce. At two or three years old, bulls frequently become ungovernable, and are killed ([124]). Many contend, that the offspring of a bull, if well bred, becomes generally better till he reaches seven or eight years, and indeed till his constitution is impaired by age ([125]). This doctrine, however, does not agree with the practice of that intelligent breeder, Mr Van de Poes in Holland; nor can the question be finally decided, without a regular course of experiments. In breeding sheep, the age of the ram is considered to be a point of less importance.

Some breeders maintain, that the offspring take considerably more after the male, than the female parent, and that the male possesses an independent quality of conferring peculiar properties on his offspring ([126]). The correctness of that opinion, is disputed in a recent essay, by an author who has paid much attention to that particular point, and has discussed it with considerable ability ([127]). He admits that the male animal affords advantages superior to the female for the improvement of the species, in as much as the female is in general restricted to a single production, whereas the services of the male are available to a great number of the other. It is admitted, that well-bred females will produce good stock with inferior bulls, as well as that well-bred bulls will produce good stock with inferior females. But the excellencies of the male are, in general, the accumulated acquisitions of many ancestors. They are positive, and in comparison fixed. Whereas cows frequently possess little, or no character, and have been bred without regard to any particular object, but the production of animals to increase the stock upon the farm. No stock, however, can be depended on for excellence, unless where both parents have acquired from their progenitors, by great perseverance, those important requisites, which are considered to be essential for the formation of a perfect breed. Where those requisites are not *confirmed* by great attention for a number of years, an animal will *breed back* in point of merit. It is necessary, therefore, in order to retain excellence in stock, that the animals be distinguished by high blood, or have a pedigree, as little dubious as possible, *for several generations.*

There is reason, however, to believe, that some parts of the offspring take after the male, and some after the female. If the female be small, and such a habit be permanent in her family, the length of the legs of the offspring will seldom be influenced by the male, but much by the female parent, while in the womb, and will not subsequently change. The width and depth, and consequently the weight of carcase, will be greatly influenced by the male; and if it be of a large kind, the offspring will present great weight in a small compass.

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This has been proved by crossing a West-Highland cow, with a Herefordshire bull, not with a view of continuing the breed, but to dispose of all the animals produced by the cross. The offspring have the short legs of the West-Highland cow, with the increased weight that might be expected from a Hereford bull. They are exceedingly hardy, their flesh is of excellent quality, and they have, at two years old, nearly the proportions of other stock at six. The females are consequently ready to be fattened at two years old. The males require to be one year older ([128]). The crossing the Herefordshire heifer, however, with a West-Highland bull, would answer better, were the formation of an entire new breed to be attempted.

Among the rules of breeding, one is, that the young should be brought forth at the season of the year when there is usually a full supply of suitable food. This is particularly necessary to be attended to, on high and exposed situations, where there is little, or no other provision than common pastures. Where this rule has not been adverted to, great losses have been sustained ([129]). It is necessary at the same time to guard against an opposite extreme, and to take care that the birth shall not be so late in the season, that there shall be any risk of the young animal being unable to bear the cold and severities of the ensuing winter ([130]).

Another rule in breeding is, never to fix on the ewes to be put to a favourite ram, until the lambs got by him, the preceding year, have been examined. The perfections and defects of his progeny are thus ascertained, and ewes are given him accordingly. By such attention, and carefully selecting from the lambs, rejecting all doubtful ones, a flock is kept in a constant state of progressive improvement ([131]).

A third rule is, in selecting a male from a small number, not to choose the weakest male, though it may possess the most delicate form, and approach the nearest to female symmetry; for if the same system were to be continued for a few generations, it may easily be supposed, that such a breed will dwindle, compared with one left to the process of nature, in which the strongest males, driving off the weakest, are exclusively employed for the propagation of the kind ([132]).

It is farther necessary to observe, that any defect in a breed, will not only be transmitted uncorrected, but will necessarily increase in the progeny; a tendency to that defect, being inherited by both parents, and both being immediately descended from its original propagator. This defect may be in respect of size, form, inclination to feed at an early age, to feed fat with a comparatively small consumption of vegetable food, to lay that fat on valuable points, or in constitutional health; and according to the nature of the original defect, the breed will become bad feeders, or incapable of producing any but an unhealthy offspring.

On this branch of the subject, it may be proper to add, that the justly celebrated Bakewell, was the founder of the improved system of breeding. He was, by nature, a strong-minded man, and a superior judge of stock for the times in which he lived. Experience, however, has since made the art more perfect, though it is of all others the one in which blunders are most easily committed. The art is eminently useful, and is capable of almost unlimited improvement ([133]); but it requires so much attention and expense, that it can never be kept up with spirit, without liberal encouragement, and good prices.

III. *On the proper Management of Stock in general.*

This is a subject which can only, in this place, be slightly touched upon ([134]). It is an object of very great consequence to every husbandman, to expend, in the most economical and advantageous manner, the vegetable produce allotted for the maintenance of his stock, and to bestow it chiefly on those, from which he is likely to derive the greatest, and the earliest benefit. Notwithstanding many recent, and truly valuable improvements, there still prevails, in regard to some particulars, a sad mixture of profusion on the one hand, and penuriousness on the other. The saving to the public, by careful attention to the feeding of live stock, would at all times be great, but in times of scarcity, would be incalculable. For the attainment of that object, it would be necessary to pay regard to, 1. The due preparation, and frugal expenditure of their food; 2. The appropriation of that food to the different sorts respectively, according to the different species and breeds of stock,—their different habits and degrees of hardiness,—and the different degrees of exercise, and modes of treatment to which they are subjected; and, 3. The requisite attention to the demands of different periods, the relative effects of different seasons, and the state of the animals themselves, in regard to age, fatness, &c. ([135]).

The following general rules, as to the feeding and management of stock, may deserve attention.

1. Animals intended for the butcher, should be kept in a state of regular improvement. The finer breeds are highly fed from their birth, and are almost always fat ([136]). With other breeds, and on pastures of inferior quality, this is neither necessary nor practicable. But in every case, the same principle of improvement should be adhered to, and such animals ought never to be allowed to lose flesh, in the hopes of afterwards restoring it by better feeding, nor removed to pastures inferior to that on which they have been usually kept.

2. The size should never be above that which the pastures can support in a thriving condition; nor can any thing be more injudicious, than to endeavour to increase the size of stock by crossing, without improving their pasture. The stock of every kind, and of all the various breeds, should, in respect of size, be proportioned to the quantity and the quality of their intended food ([137]).

3. The best pasture should be allotted to that portion of the stock which goes first to market; the next in quality, to the breeders; and the less valuable pasture, to the inferior or growing stock, without however suffering it to be overstocked. This division is highly advantageous. One hundred acres under this plan, would feed more than 120 promiscuously pastured.

4. Great care should be taken, not to overstock pasture, a practice which is attended with great loss to the farmer, and the community. This ought to be particularly avoided in regard to young and growing animals. If they are kept poor during one part of the year, they will scarcely thrive during the remainder; and when ill fed, will never attain their proper size and proportion; at the same time young stock, (their powers of digestion being stronger), may be fed on coarser and more succulent food, than those which are more advanced, and of age capable of being fattened.

5. The kind of food given to animals, should be suited to their ages. In the habit of very young animals, there abounds, and seems necessary for their welfare, a great proportion of fluid; and therefore more succulent food may be preferable for them; but when they are more advanced and vigorous, the digestive powers being stronger, and time being requisite for the process of growth, provision less immediately nutritious, or of a coarser quality, may suffice. A dry kind of food would appear to agree better with all animals *in winter*, when the perspiration is less, than in summer, during which season, moister provision would seem to be more

suitable [138]. When fed on dry food, and more especially if the quality is coarse, the stock should be well supplied with water, to promote its digestion in the stomach. It is indeed a good plan, previously to moisten any hay given to cattle, and in a less degree even to horses.

6. In regard to the diseases of stock, it may in general be observed, that the great object of the farmer ought to be, to ward them off, by obviating their remote causes; for most of those which affect our domestic animals, when once induced, are not easily cured, partly from their obscure nature, and partly from the difficulty of exhibiting remedies to the large numbers which are frequently seized at the same period, or in the same situation. In particular districts, many herds and flocks are considerably thinned, almost every year, by inflammatory and other disorders, which a little care and good treatment, applied in time, might easily have prevented [139].

Lastly, the food, whatever it consists of, should not be too suddenly changed. It is seldom profitable, to bring lean animals immediately from coarse to rich pastures; and a change from dry to succulent food, and *vice versa*, should be gradually effected [140]. A change of pasture, however, of the same quality, tends to produce a greater accumulation of fat [141].

It may be proper to add, that nature seems to have designed different sorts of animals for different purposes. A breed of cattle, equally well adapted to the butcher, to the dairy, and to the plough or cart [142], is no where to be met with; and, so far as experience enables us to judge, these properties are hardly consistent with each other, and belong to animals of different forms and proportions. A large Herefordshire ox, for instance, would starve on a Highland pasture, and heavy Leicestershire sheep were never intended to travel great distances, or to search for their subsistence in a rugged or mountainous country. The judicious breeder, therefore, will fix upon one object to be principally attended to; and he will endeavour to rear the species of stock best qualified to enable him to attain the object he has in view, or, in other words, the most likely to pay the most money, for the food he gives them. That can only be obtained, by an attention to the principles of breeding in general,—to the system best calculated for his own situation in particular,—and to the practice of the most eminent farmers who have excelled in the art [143].

In regard to live stock, in general, it may be observed, that we ought to have in view, the keeping up of such a diversity of kind, of size, and of habit, as seems best adapted to answer our principal demands, and is the most likely to agree with the situation, climate, produce, and other general circumstances of the country.

On the subject of the dairy, some observations will be found, in a separate paper. See the Addenda, No. 1.

IV. *Observations on the Size of Horses, and the most economical mode of feeding them.*

1. *Size.*—The late Mr Davis of Longleat, one of the ablest agriculturists this country has ever produced, has given some important observations on the size of horses. He laments, that the attempts which have been made to improve the breeds of horses, cows, and sheep, have proceeded too much upon the principle, *of enlarging the size of the animal;* whereas, in general, the only real improvement has been made in the pig, and that was, by reducing its size, and introducing a kind that will live hardier, and come to greater perfection at an earlier age ([144]). His objections indeed to the using of large heavy-heeled horses, in preference to the smart, the active, and the really useful breeds, merit particular attention. In some situations, the steepness of the hills, and the heaviness of the soil, require more than ordinary strength; but in such cases, he maintains, that it would be better to add to the number of horses, than to increase their size. Great horses not only cost proportionably more at first than small ones, but require much more food, and of a better quality, to keep up their flesh. The Wiltshire carter also, takes a pride in keeping them as fat as possible; and their food, (which is generally *barley*) ([145]), is given without stint. In many instances, indeed, the expense of keeping a fine team of horses, amounts to nearly the rent of the farm on which they are worked. They are purchased young when colts, and sold at five or six years of age, for the London drays and waggons. The expense of their maintenance is very seldom counterbalanced by the difference of price, more especially as such horses are but gently worked when young, that they may attain their full size and beauty. In ploughing light soils, the strength of a dray horse is not wanted; and in heavy soils, the weight of the animal does injury to the land ([146]). It is proper at the same time to observe, that horses of a great size, weight, and

strength, are of much use in war, as we experienced at the battle of Waterloo, where the smaller breeds of the enemy could not resist the attacks of the heavy British cavalry.

2. *Economical modes of feeding horses.*—It is certainly necessary that horses, which go through such severe labour as those employed by the farmer, should be well fed, and on articles of a substantial description. Thus a pair of horses fed on potatoes solely, would never be able to run two stages daily, in a post chaise, nor plough an acre *per* day every day in the year; and all good farmers lay it down as a rule, that horses should be above their labour; at the same time the heavy expense at which they are usually maintained, is extremely injurious to the public interest. It augments the charges attending all agricultural operations, and consequently unnecessarily increases the prices of provisions. It likewise adds to the expense of every description of conveyance by land, which, either directly or indirectly, must be felt by so large a portion of the community; and, thence it becomes necessary to employ great tracts of fertile land, in raising food for horses, which might be more beneficially employed in the production of food for man. I was thence led to make some extensive inquiries, regarding the various means of maintaining horses at less expense, in the course of which the following important particulars were communicated to me:

1. Mr Willan, who was interested in so many stage coaches to and from London, that he used to consume every year, about 10,000 quarters of oats, from the port of London alone, and bought at country markets about 2500 quarters more, for the horses he kept at two or three stages' distance from the metropolis, was accustomed to allow his horses as much corn and hay as they would eat; and, on an average, they consumed 2 pecks or 16 quarts of oats *per* day, and every 20 horses had a load of 18 cwt. of hay *per* week. For the last twenty years, with the exception of the two last, the best hay, (which it is always necessary to purchase for stage-coach horses), might, on an average, be about L.5 *per* load; but last year it rose first to L.6, and then even L. 10 *per* load. The price of oats also rose from 30s. to L.4 and upwards *per* quarter; at which price it became impossible to carry on the business of stage coaches without loss. It became necessary, therefore, either to give up that concern, or to devise some new mode of feeding horses.

The plan he fixed upon was to erect a machine, to be worked by two horses, for the purposes of crushing beans, and cutting chaff; and for some time, he found considerable advantage from the practice, though beans had gradually risen in price from L.3, 10s. to L.6 *per* quarter. Even at that price, however, he found it of advantage, to use *old* beans mixed with new oats and chaff, in the following manner: Having harvested well a considerable quantity of oats, it occurred to him, that it would be of use, instead of thrashing the corn, to cut the oats and straw together into chaff; and he found, that half a bushel of oat chaff, with a mixture of corn, half a peck of crushed old beans, and half a peck of new oats, was not only healthful to the horse, but sufficiently nourishing, to enable him to go through the severest labour, without being injured by it.

The public advantages to be derived from this practice, in addition to a diminution of expense, are of the highest importance. 1. The expense of feeding horses, may thus be considerably reduced. 2. It appears, that even the hardest working horses, may thus be fed, *without hay*, which will render it unnecessary to keep such extensive and most valuable tracts of land, in a state of permanent meadow, when its produce can be so much increased by the use of the plough; and, 3. As beans can be used, in nearly the same proportion as oats, it will be quite unnecessary in future, to import such enormous quantities of oats; and the beans required can, in many cases, be raised on land, now appropriated to summer fallow;—a practice, which, when beans are drilled, need only be adopted every sixth, instead of every third year, and, in the opinion of some, still less frequently.

2. An eminent coach-master in Lancashire, (Mr Brotherton of Rainhill), who kept from 70 to 100 horses for drawing stage-coaches, likewise favoured me with some important information regarding his cheap improved mode of feeding horses.

He had been accustomed, from 1802 to November 1811, to allow 8 horses, every 24 hours, three Winchester bushels of oats, and one bushel of beans, but no hay or chaff. During that time he lost a great number of horses every year, to the amount of from 14 to 17 on an average, which he attributes to his having given them too much corn, *and more than the stomach could digest.* This led him to try a small proportion of hay, and he afterwards adopted the following plan:

To every 8 horses he allowed one bushel of oats, one bushel of beans, and three bushels of cut hay and straw or

PLAN

of an

APPARATUS

For Steaming the Food of Cattle,

Belonging to, & Invented by,

MR. GEORGE BAGRIE,

FARMER, MONKTON,

Parish of Inveresk,

Mid-Lothian.

Fig. 1
Sections of Boiler Steam Cylinder & Cistern

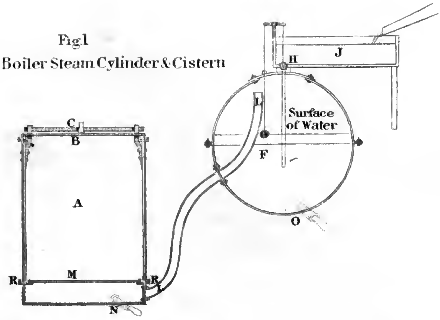


Fig. 2
Elevation

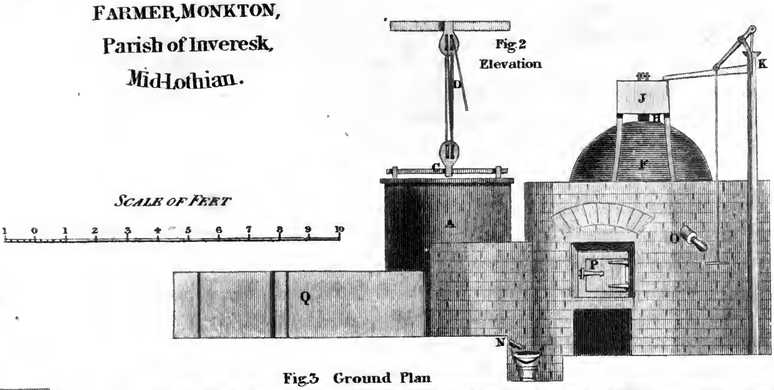
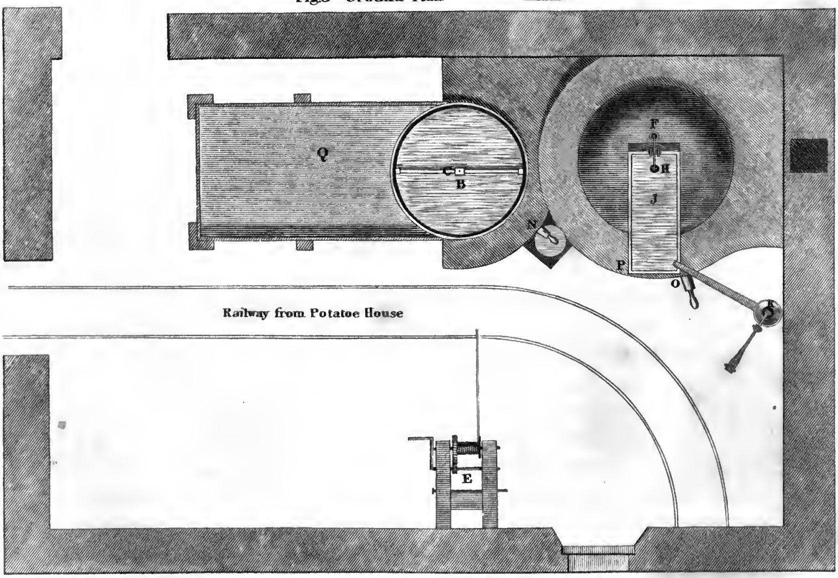


Fig. 3 Ground Plan



clover mixed, of the best sort that could be purchased, besides hay uncut. This produced a considerable saving, besides a great reduction in the quantity of oats consumed.

Mr Brotherton thinks it unnecessary to crush his beans or oats, when the horses get cut clover, hay, or straw, mixed with their corn, though before they got that mixture, the beans and oats often passed whole; but it might be still advisable to adopt the crushing plan, more especially with very young or very aged horses, where the necessary machinery can be had. He never thrashes his oats, if well harvested, but cuts them in the machine altogether. He cuts the hay and straw very short, and gives a preference to clover, if it has been cut before it has been seeded, and is well harvested.

His horses are now as healthy and able to do their work, as ever he knew them; and he has lost only one horse, since he adopted the new plan.

If he had fed his horses, according to the former plan, at the price which corn fetched in 1812, he calculates that it would have cost him at least L. 1 : 16 : 2 for each horse, *per* week; but according to the new plan, the expense is only about L. 1 : 2 : 6, making a difference of no less a sum than 13s. 8d. *per* week, or L. 35 : 10 : 8 *per annum*, on each horse.

3. Besides the articles above mentioned, there are others which might be applied as food for horses, with great advantage, without interfering with the food of the human species. Among these, the shoots of green furze have been recommended, as an excellent food for horses. It has been ascertained, that a Scotch acre of furze, will be sufficient for six horses, for four months; and as they require two years to be reproduced, two acres will be sufficient to keep them in constant supply for that time. The expense of cutting is about 1s. 8d. weekly, and of bruising a mere trifle. It is found, that by one feed of corn and furze, horses are kept in as good condition for labour, as with two feeds of corn and straw, so that one feed of corn, and the whole straw, are saved altogether. This may be stated as worth 7d. *per* day on each horse, or L. 17, 17s. on six horses for 17 weeks. The expense of cutting, bruising, &c. may be stated at 5s. weekly. There will remain, therefore, L. 13, 12s., as the produce of two acres of whins, or L. 6, 16s. *per* acre yearly.

4. It is well known, that in various parts of the kingdom, farm horses are sometimes fed on boiled potatoes, and at other times, on Swedish turnips; but an intelligent farmer,

(Mr George Bagrie, at Monkton, near Musselburgh), informs me, that the practice of feeding horses with steamed food, consisting of one-half potatoes, and the other half Swedish turnips, has existed in his neighbourhood for a great number of years, and has been attended with the greatest success. The turnips and potatoes are steamed together. One boll of potatoes is put in the bottom of the barrel, above them about eight cwt. of turnips, and then two bolls of potatoes on the top. This fills the barrel, and the turnips being in the middle, they are effectually steamed. No other food is given to the horses, but the steamed potatoes and turnips, mixed with a little chaff, or corn dust. It has been proved, that farm horses will do their work as well upon this food as on oats and hay, and they always appear in much better condition. With the addition of some straw, he has maintained his horses in this way, for six months, namely, from the 1st of November to the 1st of May. It is ascertained, that the produce of half the extent of land, will be sufficient to feed the same number of horses on this plan, that is required, when they are fed on corn and hay.

Mr Bagrie is also of opinion, that milch cows, and black cattle in general, might be fed upon this food, a small portion of salt being mixed with the liquid that flows from the steamed potatoes and turnips, and any small unmarketable grain, ground down for the purpose, being added to it. This food, he is convinced, would equal any produced by the distillery; and cattle would fatten better in two months, when thus fed, than in four as they are usually treated. But they should be tied up in a warm place, and their food given them warm.

The apparatus for carrying on this process, varies in price, according to its size, from L.15 to L.100; and may be had at Gutzmere's old work, at Leith Walk, near Edinburgh. The white yam is the preferable sort, and the potatoes, when used, should be large. The plan suits all kinds of horses, excepting those employed in hunting or the turf, or in running in the mail.

If these practices were to become general, on farms calculated for growing potatoes and Swedish turnips, it would render us independent of foreign countries for oats, and the expense of raising grain would be greatly diminished. This is an ample proof of the extent of our agricultural resources, if encouragement were given to the art, and if the useful practices discovered in one district, were transferred to, and adopted in, other parts of the kingdom.

5. When articles of food become scarce and dear, it is of great importance to discover any mode, by which the article to be used, can be made to go farther. In such a case, labour or expense, properly applied, is not to be put in competition with the advantages of diminishing the quantity of food consumed. Two plans may be adopted for that purpose; either preparing the article for consumption by machinery, or by cookery.

It is well known that hay or straw, will go much farther, when cut, than when entire. If a horse is compelled to cut these articles with his teeth, the labour occasions a diminution of strength; and the time it requires, diminishes what might be devoted to repose. It is now pretty generally admitted, that the saliva from the mouth is not essential for promoting digestion; that important operation being chiefly performed by the gastric juice in the stomach. If therefore the nourishment is put into the stomach, in a state fit for the gastric juice to act upon it, whether that is performed by machinery from without, or by the teeth within, is immaterial. Hence, it appears, that machines for cutting hay or straw, are highly beneficial.

Nor is it of less importance, to crush the corn given to horses, whether beans or oats, particularly the former, which become extremely hard, when long kept. If the gastric juice finds any part that it can act upon, however small, it will digest the whole; but it ought, if possible, to have that advantage secured to it.

It is likewise an additional improvement, to prepare the food of our domestic animals by cookery. Steaming potatoes is of use, by preventing the deleterious effects of the skin of that article, from which, when given in a raw state, many horses having suffered; and those who have tried steaming chaff and potatoes, or giving their horses a mash of boiled barley, will not be readily induced to give up these practices. Indeed, barley, in a raw state, is preferred to oats, in Wiltshire, for feeding horses; and in the southern parts of Europe, that species called bear, or big, is usually given them; and with it they thrive as well, and it is said, can go through as much labour as when fed on oats. When oats therefore are dear, and barley cheap, it may be worth while to give horses alternate feeds of each article.

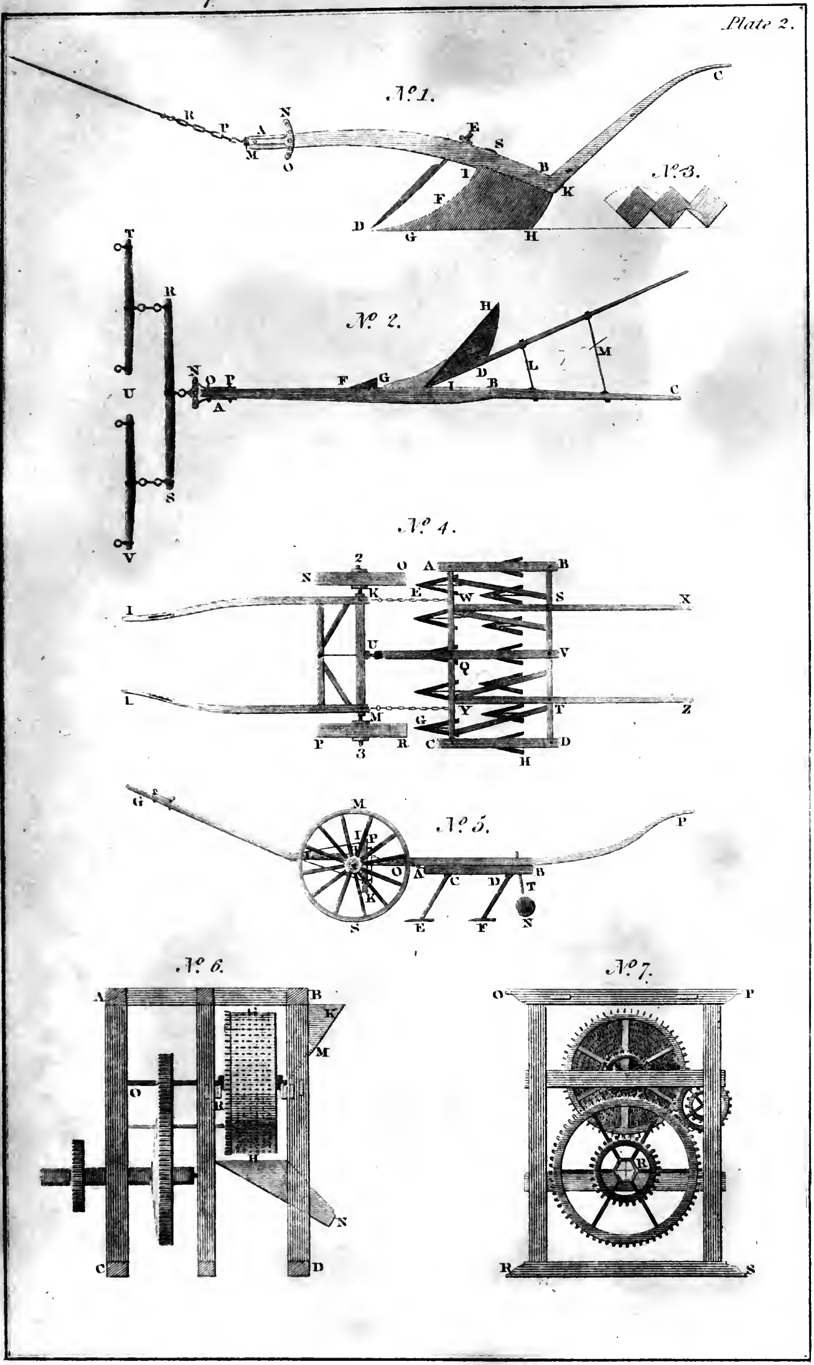
On the whole, these hints are submitted to the consideration of those who may be desirous of diminishing the expense of maintaining horses, not only for their own advantage, but also with a view of lessening the consumption, and diminishing the price of provisions when the price is too high. The foundation of a system may thus be laid, by which the operations of the farmer may, in future, be carried on at much less expense, and the importation of foreign produce of so indispensable an article as food, in a great measure rendered unnecessary.

Sect. VII.—*Implements of Husbandry.*

The superiority of British husbandry over that of other nations, may, in a great measure, be attributed to the numerous valuable implements employed in executing the various processes of agriculture. Both the abundance of capital, and the ingenuity of our mechanics, have produced that important advantage. The number of these implements, however, is so great, that the prudent farmer, in regard to that, as well as in every other branch of his art, must study economy. He should not incur an unnecessary expense in buying them, nor in purchasing more, than are essentially requisite, and can be profitably used. This maxim ought to be more especially attended to by young improvers, who are often tempted, under the specious idea of diminishing labour, and saving expense, to buy a superfluous quantity of implements, which they afterwards find are of little use ([147]).

In purchasing implements, the following rules are to be observed: 1. They should be simple in their construction, both that their uses may be more easily understood, and that any common workman may be able to repair them, when they get out of order. 2. The materials should be of a durable nature, that the labour may be less liable to interruption from their accidental failure. 3. Their form should be firm and compact, that they may not be injured by jolts and shaking; and that they may be more safely worked by country labourers, who are but little accustomed to the use of delicate tools. 4. In the large machines, symmetry, and lightness of shape, ought to be particularly attended to; for a heavy carriage, like a great horse, is worn out by its own weight, nearly as much as by what it carries ([148]). 5. The wood should be cut up and placed in a position, the best calculated to resist pressure; and mortises, so likely to weaken the wood, should, as much as possible, be avoided;

Engravings of the Improved Sowing Plough; Grubber; and Pot-Barley Mill.



Neele sc. Strand

at the same time, implements should be made as light as is consistent with the strength that is necessary. 6. Their price should be such, that farmers in moderate circumstances can afford to buy them; yet for the sake of a low price, the judicious farmer, will not purchase articles, either of a flimsy fabric, or a faulty form; and, 7. Implements ought to be suited to the nature of the country, whether hilly or level, and more especially to the quality of the soil: for those which are calculated for light land, will not answer equally well in soils that are heavy and adhesive.

The subject of implements may be considered under the following general heads: 1. Implements of tillage; 2. For drilling or sowing corn; 3. For reaping corn; 4. For harvesting corn; 5. For thrashing and cleaning corn; 6. For mowing and harvesting hay; 7. Of conveyance; 8. For draining; 9. For harnessing stock; 10. For rolling land; 11. For the dairy; and, 12. For various miscellaneous purposes. The intelligent farmer will be enabled to judge, from the description thus laid before him, what implements are the most essential, and the best suited for the purposes he requires.

It is proposed to conclude with some remarks on the use of the spade in husbandry.

1. *Implements of Tillage.*

These consist of ploughs, harrows, horse-hoes, scufflers, and a more recent invention, known under various names, scarifier, grubber, &c.

1. *The plough.*—It is proper to begin with the plough, being the chief of all the implements employed in the extensive art of agriculture. There are several instruments used in husbandry, which, perhaps, might be dispensed with; but land cannot be cultivated to any considerable extent, or to much advantage, without the plough: for it is by means of that implement, that the strength of domesticated animals can be most usefully employed in the cultivation of the soil. In the formation of ploughs there is a great difference; and indeed they vary in almost every county, according to the nature of the soil, and other circumstances. But the great distinction necessary to be adverted to in this place, is, between the swing plough, and the wheel plough.

1. *The swing plough.*—The advantages of the swing plough, compared with the wheel plough, are, that its original cost

is less;—that it is more easily kept in repair;—that, when properly made, it requires less strength to draw it;—that it is not easily put out of order;—that it is peculiarly well calculated for light soils;—and that when the land is at all wet, it is not liable to be clogged ([149]).

As a decided proof in favour of swing ploughs, it is stated, that a farmer, accustomed to wheel ploughs on the light soils of Norfolk, proposed using them on a farm of strong loam in Suffolk, to which he had removed; but upon trying swing and wheel ploughs against each other, he was soon convinced, that the latter fatigued the horses more than the former; and that with wheel ploughs, he could not support his horses in such good condition, as with swing ones. He is now satisfied, that this would likewise be the case, even in light land ([150]).

These observations, however, apply to swing ploughs made on a light and ingenious construction, and not to those used in Middlesex, and other districts, which are of so clumsy and heavy a form, as to require the draught of one, or even two additional horses ([151]).

It is at the same time to be remembered, in regard to swing ploughs, that they require experienced labourers. But where these can be had, a swing plough, with a pair of horses abreast, is a most efficient implement. Whether it will work any land at all seasons, is a subject of much dispute ([152]). It is contended on the one hand, that a union of drying winds, with much heat, continued for a few weeks in summer, renders any clay land hard and difficult to plough; and in such cases, if the clay should happen to be mixed with gravel, flints, or pebble stones, they become so firmly fixed, as to bid defiance to the efforts of swing ploughs. On the other hand, it is observed, that if all these circumstances were admitted, it does not follow, that wheel ploughs are necessary to working the land, when it has got even into the hard state above described. That swing ploughs will answer *in the proper season*, even though the ordinary strength is only employed, is unquestionable; and when the proper season has been neglected, all that is required is, to increase the strength of the impelling power, by means of which, every difficulty may be surmounted ([153]).

2. *Wheel ploughs.*—The advantages of wheel ploughs are, that they require less skill in the ploughman;—that they keep a more regular depth ([154]), and will turn a shallower furrow;—that they afford assistance to the ploughman in soils of a stubborn, adhesive, or stony quality;—and that

they are better calculated for trench ploughing. But, on the other hand, they are more expensive both to purchase and repair;—they are more liable to be put out of order;—they require more strength to work them;—they are more easily disturbed by inequalities on the surface; they encourage the workman to rest a part of their weight on the handles of the plough, by which the draught and friction are so much increased, that both the horse and the plough wear out much sooner ([155]);—and neither good mechanics, nor able ploughmen, can ever become numerous, while their ignorance, or their unskilfulness, can be so easily remedied, as by adding wheels to the plough ([156]). Hence, in various places where experienced ploughmen could be had, wheel ploughs have been given up, as expensive and cumbersome ([157]).

Wheels, however, are found to be useful, in cases where either the trench, or the double-furrow plough is employed.

1. By the *trench plough,* two or more slices are taken with the same instrument. The first cuts off the weeds and stubble, and deposits them at the bottom of the furrow: the second slice is turned over the former, and completely covers it. This process suits only rather deep soils; and in them, many farmers consider it to be an advantageous mode of culture. The ploughs by which this process is effected, ought always to be furnished with wheels, in order that the deepness of the slice or furrow, may be properly regulated ([158]).

2. *Double-furrow ploughs* are recommended from high authority, as saving the attendance of one person, and doing nearly double the work, in the same space of time, with little additional strength in the team ([159]). They seem to be well calculated for level land, free from stones; or where the soil has been previously well reduced by other ploughs, but they are evidently less fit for general use than single ploughs. They may answer for giving the seed furrow to barley land, where the soil is sandy, and has a flat surface ([160]); but they will not work where the land is formed into narrow and elevated ridges.

The *paring ploughs,* which have been long used in the fens, instead of a coulter, have what is called a *skeath,* or circular plate of iron, turning constantly round, the edge of which, and also of the share, are steeled, and kept sharp by a file, for cutting the turf ([161]).

Swing ploughs, on the whole, are greatly preferable for general purposes. The Rotherham plough, *(with a straight mould-board)*, was, it is said, the first light swing-plough, adapted for two horses, that was used in England. From Yorkshire, it was introduced into Suffolk, and other English counties, and into Scotland, about the year 1742 ([162]). But it was not till the year 1764, that a plough, with *the curve mould-board*, was manufactured by Small, an ingenious mechanic in Berwickshire; and he afterwards made a still greater improvement, that of forming the mould-board of cast-iron, instead of wood covered with plates of iron, as it formerly was. This plan was of great use, not only on account of the cheapness and durability of the metal, but as, when a mould is once formed on correct principles, any number can be cast, and sent to any part of a country, and thus, nothing is left to the ignorance or caprice of country artisans, in the construction of this important part of the instrument ([163]). Latterly, the whole implement has been made of iron, which is not affected by any weather, nor liable to suffer from any climate. The most recent improvements in the plough have been made by Mr Wilkie of Udingstone, near Hamilton; in particular by his introducing a wheel under the plough, by which the friction of the sole of the plough, on the bottom of the furrow, is in a great measure prevented. It has been calculated, indeed, that with this improvement, a plough is drawn with one-fourth, and, in some circumstances, nearly one-third less power, than on the former construction.

2. *Harrows.*—Implements of this description are necessary in the practice of husbandry, to pulverize the ground,—to clear it of weeds,—to prepare it for the operation of sowing,—and to cover the seed when sown. It is evident, that the construction of harrows ought to depend on the nature of the soil. Those which are best calculated for strong clay, cannot be the most suitable for light sandy soils. The following are the principal rules regarding the formation of harrows: 1. That not any two of the teeth should move in one track; 2. That the tracks should be at equal distances from each other; and, 3. That the teeth should either be round, or perhaps with a sharp edge bent forward, like so many coulters, as they make themselves cleaner than when they are square, or of any other shape, and work easier after the horses. The teeth of harrows are frequently made of unequal lengths, the front row being about half an inch longer than the second, and the third row being about one

inch shorter than the first; so that each row backwards, is about one-half inch shorter than the one that precedes it. Where crops are drilled, an instrument called "the drill "harrow," is found a very great improvement. It thoroughly cuts the weeds in the intervals, and harrows them up to the top in a very complete manner.

Mr Finlayson's patent harrow, more especially with Wilkie's improvements, has been strongly recommended. Land that has been ploughed in winter, can, with this instrument, be prepared in spring, for potatoes or other crops, to better purpose, and with less labour, than, it is said, can be accomplished by any other means, nor does any implement clean the ground of weeds more effectually.

Horse Hoes and Hand Hoes.—The horse hoe is a useful implement, calculated not only for destroying weeds, but also for pulverizing the soil between the rows of plants set in straight lines, such as turnips, potatoes, or any sorts of grain, that have been sown in drills, at regular distances from each other. By these simple and effectual instruments, a great deal of manual labour is saved. At the same time, the hand hoe is necessary for cutting up weeds, and loosening the earth between the plants which the horse-hoe cannot reach. Essex is celebrated for the strength and massiness of its hand-hoes. Indeed the very weight of such an instrument falling upon the weeds, has more effect upon them, than the common hoes, with the usual strength that is applied. To render them more efficacious, the labourers are naturally anxious to have the instrument, when used, properly ground or sharpened, and the farmers in general, have a grindstone fixed on their premises, for that special purpose.

4. *The Scuffler.*—This implement is derived from the Kentish nidget. It was originally, a small triangular and heavy harrow, the tines longer, and inclined forwards,—sharp and penetrating, but having *no plates* at bottom. Afterwards however, a number of triangular plates, or feet, the edges of which are steeled, and fixed at the bottom of as many iron bars, somewhat similar to the legs and feet of a duck ([164]) were added to it. It is a useful instrument on light lands, that are free from stones, and of a plain surface, because it not only cuts up weeds, but pulverizes the soil. Scuffling strong land, and exposing it to the sun and air, is greatly preferable to harrowing, which tends to consolidate the surface ([165]); but it is necessary to have the land well reduced before the implement is employed.

5. *The Eradicator.*—This is a most effective instrument for cleaning turnip fallows, and is in general use, upon the best cultivated light land farms in West Norfolk. The share of this implement, goes to the full depth of loosening the cultivated soil, without exposing a fresh surface to be acted upon injuriously, by a hot sun, or partial drought.

6. *The Scarifier*, or *Grubber.*—This is an improvement on the scuffler, by having the iron bars bent forward for the purpose of penetrating the soil, and *combing up*, or dragging the root-weeds to the surface [166]. It is such an efficient implement, that the occupier of no extensive farm should be without it. If the ground has been previously completely loosened by the plough, it tears up the couch and other root-weeds, and brings them to the surface; acting at the same time, both as a sort of plough and harrow, with this additional advantage, that by using it, instead of a plough and harrows, moisture is retained in the ground even in the driest seasons, and the growth of the turnip crop is most essentially benefited. Light land cannot be ploughed too seldom, when it can be maintained in good heart, and kept clean by other means. The coulters are put either in a square, or in a triangular wooden frame, with a small wheel, made of cast-iron, placed at each angle of the frame, which roll on the land, and regulate the depth to which the shares are intended to penetrate the ground. It is now frequently made entirely of iron, at an expense of about L.11. Such is the utility of this implement, in saving ploughing, and keeping the land clear of weeds, that it is supposed to have added considerably to the value of every farm where it has been introduced. Indeed, not only is labour diminished by the use of the scarifier, but that instrument may be employed to advantage in the following cases: 1. Barley and turnip land, after being once ploughed, may be made both clean and fine, by its means, and the harrowings and subsequent ploughings are thereby rendered unnecessary [167]. 2. Where lands have been ploughed in autumn, the objection to the sowing of spring crops on the winter furrow, may be obviated, by the use of the scarifier [168], as not only barley, but oats, (if not grown after grass), beans, pease, and tares, may be sown without an additional ploughing. 3. Summer fallows may likewise be advantageously carried on with fewer ploughings, earlier in the season, and at less expense [169]. 4. It may be effectually employed, to forward operations in the preparation of land, for potatoes or turnips, and afterwards for raising the potatoe crop; and, 5. Its utility in mixing lime

or compost with the soil, is of the highest importance, as it not only incorporates these manures more effectually than the plough, but never places them beyond their proper depth. Hence the scarifier or grubber, is considered to be one of the greatest improvements in the culture of the soil, that modern times can boast of (170).

2. *Implements for sowing Corn.*

Corn is sown, 1. By the hand; 2. By drill machines; or, 3. By dibbling.

1. *Hand-sowing.*—Though there are machines for sowing grain, and small seeds, not in regular rows, yet the most general mode, where drilling is not practised, is by the hand. In hand-sowing, it is necessary to have the assistance either of a hopper or of a linen-sheet. A hopper or basket, is a useful implement for the purpose, as with it, the man has considerable freedom in stepping, which is of as much importance as the management of the hand (171). The sower likewise can fill a hopper himself, without the aid of another person (172). In several districts, they use a hopper made either of chip or straw, bent so as to favour the side of the man who sows the grain, and swung by a strap over the shoulder; but on the whole, the sower walks rather more at his ease, with the corn in a sheet, than when it is carried in a basket (173).

2. *Drill-machines* (174).—It is certainly desirable, that every species of seed should be sown in a regular manner, and at a proper depth, and a variety of useful machines have been invented for that purpose. They have been objected to, on account of their being complicated and expensive; but in these respects, improvements have been already made, and there is reason to hope, that they may still be brought to greater simplicity and cheapness.

To facilitate the operation of drilling grain, much ingenuity has been displayed. The drills of the Rev. Mr Cooke, and of Mr Bailey of Chillingham (175), have been deservedly celebrated. A new machine, invented by Mr Frost, late of Saham, was exhibited at Holkham, and met with much approbation. It is peculiarly calculated for strong land, and the improvements which it presents, tend greatly to remove the objections which have been made to the general adoption of the drill system. A machine, invented by Mr Checketts of Belgrave Hall, near Leicester, with some improvements by Mr Morton of Leith Walk, perhaps equals any hitherto constructed, for simplicity and usefulness.

The simple drill machine for sowing turnip-seed, cannot be too much recommended. It has been the means of rapidly extending the culture of that valuable plant. Various useful machines for drilling pease and beans have likewise been constructed; and an implement has also been invented, which not only sows grain, or turnip-seed, but also gives out at the same time the pulverized manure to be used with them.

Connected with the drilling system, are the various implements used for hoeing; in particular, a machine invented by the ingenious Mr Blaikie, called "The inverted horse-"hoe," which tends greatly to improve the system of sowing turnips on ridges; the soil being thrown inwards, instead of encumbering the young plant. The principle is adapted at pleasure, to single, double, or treble rows of turnips; and to wheat, drilled, at nine inches interval; as well as to pease and turnips at eighteen, or twenty-seven inches. ([176]). These hoes were first used at Holkham, in 1816. They have now spread all over the country, and are found much superior to any horse-hoes hitherto invented, for the purpose of cleaning all crops, sown in rows, whether at wide or narrow intervals.

Among other machines calculated for the row-culture, the drill-barrow ought not to be omitted, being peculiarly adapted for small farms. It is very simple, and may be used in two ways: 1. Either a box or barrow is attached to the plough, by which the seed is deposited in the furrow as the plough goes along, and it is covered by the next furrow slice; or, 2. A boy, with a barrow, follows the plough, depositing the seed in the bottom of the furrow ([177]).

3. *Dibbling.*—This practice has many admirers, and was for some years much used in Norfolk, for wheat, till the price of labour rendered it too expensive. On the whole, it is rather on the decline, being found minute and troublesome. The tools used are simple, being merely an iron dibble, about three feet long, with the point of which, holes are made for the reception of the seed. The dibbler walking backward, holds one in each hand, with which two holes are made at the same instant, about four inches from each other, and one or two inches deep; while women or children follow, and drop in the seed ([178]). In light soils, this plan seems to be well calculated for clover leys, the pulverization of which is unfavourable to the culture of wheat;

whereas, by these instruments, the seed may be dibbled into the very centre of the *flag*, or furrow-slice, (two rows in each), and the plant has thus a better hold of the ground. But whenever the soil has any mixture of clay, the dibbling of wheat has an injurious effect on the soil, which stints the growth of the plants ([179]). In Gloucestershire, they dibble beans and pease, and many consider it a better plan than drilling them, unless in loamy soils ([180]). The bean drill, however, on strong clays, answers the purpose effectually, and with more expedition.

3. *Implements for reaping Corn.*

Crops are cut down, by British farmers, by the sickle, the reaping-hook, or the scythe.

The sickle is light and narrow, and has teeth; the hook is heavy and broad, and has a smooth edge. Respecting the comparative merits of these tools, there was formerly a difference of opinion; but it is now generally admitted, that, for the operations of what is technically called *reaping*, those with teeth, are preferable to the smooth ones, owing to the time required in sharpening the latter; for those with teeth, may be employed for several weeks without being sharpened, and the smooth ones require sharpening several times in an hour. Where the art of bagging is introduced ([181]), the hook without teeth is indispensable. But in the fen countries, they reap oats, and sometimes barley, by the hook, the straw being long, and the crop often much inclined, the work could not be commodiously executed with sickles.

The expense of cutting down by the scythe, is less than by the sickle; and, in a wet season, corn cut down by the scythe is more easily harvested, or is less apt to heat in the stack-yard. The celebrated Culley preferred the scythe for barley. It is, however, objected to that instrument, that it does not lay the ears of the corn so regularly, as is done by the reaping-hook. This is a great disadvantage where the thrashing-mill is employed, as the corn should be put into the mill as straight and regular as possible.

A method of reaping, new to us, has lately been introduced from Flanders. It is executed in the following manner: The reaper carries in his left hand, a stick with an iron hook, with which he collects as much grain as he can cut at one sweep, with a short scythe which he holds in his right hand. By practice, they are able to carry on this double process, with great spirit and dexterity ([182]). Cradle scythes have also been tried, but they do not work well, where corn is long, or bending, or foul, or where it is grown in rows.

Various attempts have been recently made to construct reaping machines. If they could be supplied at any reasonable expense, their advantages would be very great; for, though they can hardly succeed in rough and uneven fields, yet, on level ground, they may be brought to answer. The general price of reaping with the sickle or the hook, is about twelve shillings per English acre. But with a well-constructed machine, if such could be invented, the expense would necessarily be considerably reduced ([183]).

4. *Implements for harvesting Corn.*

It is now generally admitted, that the best mode of harvesting crops of grain, is by carts. They are more easily loaded and unloaded, and managed with less difficulty than waggons.

For the preservation of corn, stacks are greatly preferable to barns, more especially since the plan has been adopted, of placing them on stone or cast-iron pillars ([184]), by which the corn, being clear from the ground, is kept perfectly dry, and the access of mice or other destructive vermin is greatly prevented. The advantages resulting from these practices, may be estimated at above one-thirtieth part of the crop ([185]).

In some districts, if the season be wet, stacks have *bosses* placed in the centre, consisting of a triangle of wood, through which the air has freedom to circulate, nearly to the top of the stack; and which is of great service in preventing the grain from spoiling, if it be not perfectly dry when harvested.—(*See the Engravings*, Plate III.) ([186]).

5. *Implements for thrashing and cleaning Corn.*

There are three sorts of machines calculated for these purposes: 1. The thrashing machine;—2. A machine for dressing barley;—and, 3. Fanners, or winnowing-machines.

1. The thrashing-machine is considered to be the most valuable implement that modern times have produced. The saving of manual labour, and that of a severe kind, by means of this invention, is perhaps beyond calculation, while the grain is separated from the straw, in a more perfect and expeditious manner, than has hitherto been accomplished by any other mode. Nothing could be more barbarous, than

the modes adopted by some of the ancients of separating the grain, as either burning the straw, or treading the corn with the feet of horses or oxen; nor could any species of labour be more fatiguing, than thrashing, by so defective an instrument as the flail. Thence many attempts have been made, at various times, for constructing machines, competent to the task of thrashing in a superior style. It is to the ingenuity of a Scotch mechanic, (Andrew Meikle), that we are indebted for the perfection, if not the sole invention of a machine adequate to that purpose. To him, at any rate, must be attributed the merit, of suggesting the drum, with fixed beaters, by which the corn and straw are separated in the most satisfactory manner. In other attempts to construct this implement, the plan of the flax-mill had been adopted ([187]).

Thrashing-mills are driven by various powers, as by horses;—oxen ([188]);—wind alone;—wind, or cattle when the wind fails;—water alone, or by cattle when the water is deficient;—and steam. Portable machines are not uncommon in various parts of England; and with them, from 16 to 24 quarters of wheat, or 33 quarters of rye, have been thrashed in a day ([189]). Some machines are driven by manual labour, and they may be adequate to thrash the crops grown on small farms, by introducing only the head of the grain into the machine ([190]); but even in that case, a moderate-sized horse, or ox, or water, or wind, would be a better power to apply. On the whole, it is most advisable, to have the mills of a substantial construction. The saving a little money, and getting a bad machine, is wretched economy. A six-horse power is little enough for all the necessary operations, on a farm where wheat is cultivated; though, by shortening the drum, fewer horses may be used.

The specific advantages resulting from this invention, may be thus briefly stated: 1. From the careless and defective manner in which grain is too often thrashed by the flail, it is calculated, that from one-tenth to one-twentieth part more corn is gained from the same quantity of straw, than by the old method. 2. The work is done much more expeditiously. 3. Pilfering is in a great measure avoided. 4. The grain is less subject to injury. 5. Seed corn can be procured without difficulty from the new crops, for those to be sown. 6. The market may be supplied with grain more quickly in times of scarcity ([191]). 7. The straw, softened by the mill, is more useful for feeding cattle. 8. If a stack of corn be heated, it may be thrashed in a day, and the grain, if kiln-dried, will be preserved, and rendered fit for use. 9. The thrashing-mill lessens the injury from smutty grain, the balls of smut, not being broken, as when beaten by the flail; and, 10. By the same machine, the grain may be separated from the chaff and small seeds, as well as from the straw. Before the invention of thrashing-mills, farm-servants and labourers endured much drudgery; the large corn farmer sustained much damage from bad thrashing, and had much trouble, vexation, and loss, from careless and wicked servants; but now, since the introduction of this valuable machine, all his difficulties in these respects, are obviated.

Mr Brown of Markle, in his Treatise on Rural Affairs, has presented the following estimate of the profit that might be derived by the public, were thrashing-mills used in every case, in this country, for separating corn from the straw. He calculates,

1. The number of acres producing grain in Great Britain, at	8,000,000
2. The average produce in quarters, at 3 qrs. per acre, at	24,000,000
3. The increased quantity of grain produced by thrashing-mills, instead of using the flail, at one-twentieth part of the produce, or in quarters, at	1,200,000
4. The value of that increased quantity at 40*s.* per quarter	£.2,400,000
5. The saving in the expense of labour, at 1*s.* per quarter	£.1,200,000
6. The total profit *per annum*, to be obtained, at	£.3,600,000
7. The actual profit *per annum*, on the supposition that only half of the grain produced were thrashed by machines,	£.1,800,000

It is not then to be wondered at, that he should pronounce the thrashing-mill, to be the most valuable implement in the farmer's possession; contending, that it adds more to the produce of the country, than any invention has hitherto done; and that it ought to be accounted the greatest improvement that has been introduced into Great Britain, during the present age ([192]).

But the principal objection to a thrashing-mill is, the great diminution which it occasions, in the means of employment furnished to the agricultural labourer, whose chief occupation, in the winter season was, the thrashing of corn. To obviate that objection, it has been suggested to adopt the plan practised in some parts of that celebrated agricultural district Somerset, where wheat is seldom thrashed with the straw, but the ears are cut off, and the grain separated by manual labour ([193]). This is a plan strongly to be recommended to the attention of farmers, in every district, where any difficulty is found in providing employment for labourers, and where thrashing-mills are therefore so obnoxious. This plan may be attended with some additional expense, but then it possesses the following advantages: In the *first* place, scarcely an ear of wheat is lost in the operation of thrashing; 2. The straw is more valuable for thatching; indeed, nothing can exceed the beauty of the roofs thatched with straw thus prepared, and they are more durable, furnishing no attraction to rats and mice; and, 3. The straw lasts much longer as litter, an important object where that article is expensive.

2. A machine has been invented for dressing, or taking off the awns or spikes of barley, which is recommended as a great improvement by those who have used it. Sometimes it is attached to thrashing-mills; and though that must occasion some additional stress to the power by which it is moved, it is but trifling ([194]). In well-constructed thrashing-mills, however, this operation is frequently done by the mill itself.

3. Many imperfect modes were used, in former times, for separating the grain from the chaff, as by dropping it from a sieve or basket, between the two doors of a barn exposed to the wind;—by throwing or *casting* it with shovels;—and by the common method of the *fan* and *riddles*, to which was sometimes added *reeing*, and hand-dressing. In modern times, machines have been constructed, to blow, riddle, and skreen at one operation. By the use of these implements, the husbandman can clean his corn at any time when necessary ([195]). Fanners, or dressing machines, have been greatly improved since their first introduction, and are now to be seen, not only in every corn-mill, but almost in every barn, where the farm is more employed in tillage than grazing. When annexed to thrashing-mills, and properly fitted up internally, with suitable riddles, and harps, or skreens, corn is often rendered fit for the market, as it comes from the machine ([196]).

6. *Implements for sowing grass-seeds, and for making and harvesting Hay.*

A machine for sowing grass-seeds broad-cast, is now in common use upon large farms in Norfolk, and is much approved. It may be used in windy weather when grass-seeds cannot be sown properly, in the common way; and it sows more expeditiously, and more correctly, than can possibly be done by hand in any weather. It is drawn by a horse, attended by one man to guide the machine, and a boy to lead the horse, and sows from 25 to 30 acres a-day.

Such a machine, should be purchased for general use, in every district where much grass-seeds are sown.

The scythe, an essential implement for cutting grass to be converted into hay, is so well known, that it does not require to be described ([197]).

Instead of the usual mode of *tedding* grass, or shaking it out of the swathe, and strewing it evenly over the ground, for the object of drying it expeditiously, a machine has been invented, of a circular form, with spikes, by which the largest crops are separated, thrown into the air, and scattered about in a very perfect manner. By this means, the manual labour of tedding natural grass is abridged, and the work is done better and more quickly. It is not, however, calculated for clover, which ought to be as little shaken as possible, its head and leaves being so apt to break off.

When the intention is, to stack the hay on the field in which it grew, and it has been formed into large windrows, it may then be put into what is called "*a sweep*," a machine made of wood, for holding the hay, by which it may be dragged along the field to the place where it is to be stacked. This machine is so easily and expeditiously loaded and unloaded, that it may be of great use in securing the hay in precarious weather ([198]).

7. *Implements of Conveyance.*

The inconvenient, tedious, and expensive modes of conveying agricultural productions, on the backs of horses, on hurdles, or on sledges, are now rarely to be met with. The usual means of conveyance now are, by the cart, the Irish car, the tumbril, and the waggon.

1. Carts are beyond doubt the cheapest, and also the best kind of carriage for the farmer. They may be used in almost any situation. In a flat country, they are evidently preferable to any other; and though in a hilly district, some objections may be made to them, when going either up or down hill; yet on the whole, no other carriage can be dragged up so easily, and means have been invented by which their safe descent may be facilitated and insured. By means also, of a light frame, or what is called a *harvest top*, (which may be occasionally fixed upon them), carts are rendered fit for carrying a considerable quantity of corn, hay, straw, or other bulky, but light articles.

It has been much disputed, whether carts should have one, two, or even more horses. It may be proper therefore, to give a general view of the arguments in favour of single-horse carts, as the subject is of much importance, and the difficulty of surmounting the prejudices against such carts, in those places where larger machines have been in use, is very great.

In behalf of single-horse carts, it is contended, That they are cheaper, both in regard to the original cost, and the repairs;—that greater loads are carried per horse [199]; —that they are more effective in harvest than the waggon [200];—that they are less liable to loss by accidents; for if one wheel of a waggon breaks down, the whole team is stopped;—that the division of draught is useful, for no skill in driving, can make all the horses in a waggon draw exactly an equal share;—that they are loaded with greater ease and convenience, and are handy for almost every purpose;—that the size of the wheels may be adapted, with the greatest nicety, to the height of the horses;—that the load may be so conveniently placed, as to lessen the draught;—that in proportion to the load, the cart has less weight of carriage;—that the power is nearer the weight drawn;—that they occupy less space when out of use, than waggons; —that it is much better for the horses to act singly than conjunctively, as a horse in the one case, has nothing but his load to contend with, whereas in the latter, he is generally embarrassed by some difference in point of rate of going, greater or lesser height, strength, temper, &c. with his companion in the machine [201]; and lastly,—that single-horse carts are greatly to be preferred for the preservation of roads [202].

Others maintain, that single-horse carts can only be beneficially employed in dry weather, when the roads are good; and though in such roads, one man can manage two of these machines, yet, that in general, each single horse cart must have a man to drive it, which is of itself an objection of great importance, more especially during the harvest, when hands are scarce.

In regard to double-horse carts, many farmers are partial to them where much field labour is to be performed, and where the roads are so bad, that a single-horse cart can make but little progress. In drawing up steep banks, or going to a great distance for lime, &c. two horses may likewise be desirable; at the same time it is admitted, that such a load as two horses can draw, would be so heavy, that in going over a farm, the wheels would sink into the ground, to the great injury of the land, particularly when in grass.

The practice of putting three or four horses in a cart, (as is done in the neighbourhood of the metropolis), deserves reprehension. When such carts are empty, they are considerably heavier than one horse can draw in constant work ([203]); and seldom much more than a ton is conveyed by such carts, even with three or four horses ([204]).

Where oxen are used, it is better that they should be yoked in pairs; and Lord Somerville, with his usual zeal for agricultural improvement, has given the description of a drag cart for two oxen, by which they would be able to draw a considerable weight, even in a hilly country ([205]).

2. Irish cars have their advantages. They are easily filled;—pass confined gateways with facility;—can be drawn upon soft meadow or ploughed grounds, with little injury or inconvenience;—and the wheels being cylindrical, they are much less destructive to roads. They were recommended, for these reasons, by Bakewell, and the late Mr Wilkes of Measham, ([206]); but they do not carry such heavy weights, as single horse-carts will convey ([207]). The Irish car has, of late, been much improved, having got iron axle-trees on the same plan as carts ([208]).

3. Tumbrils with three wheels, are of use for particular purposes; as, for carrying dung, or conveying marle from a pit. But they are not adopted to any great extent.

4. Where the country is level, the roads free from ruts, and the people rich, (as the brewers, distillers, and some farmers of Surrey and Middlesex), they indulge in expensive horses, and teams of parade and show ([209]); but in general, these teams are but little adapted for agricultural purposes, more especially for the corn or hay harvest, when expedition is so essential. Heavy waggons also, are greatly to be objected to in hilly districts, as the wheels must be frequently locked, by which the roads are ploughed up, and most essentially injured.

8. *Implements for harnessing Stock.*

Harness, or the traces, trappings, yokings, and furniture of animals employed in draught, are articles of considerable expense, but of great utility. If the best mode of applying the power of different animals by proper ligaments, as well as the materials of which they ought to be made, be taken into account, it will be evident, that the subject is of more importance, than farmers seem in general to be aware of. Economy, however, in this article, where it does not interfere with fitness, should be particularly adverted to [210]; above all, throwing away money in useless ornaments, ought to be avoided. Great care ought likewise to be paid to the preservation of the harness, as it consists of articles easily damaged, unless kept in the most perfect order.

9. *Implements for draining Land.*

In the implements for this essential purpose, England certainly excels. Where the ground is soft, the drains may be cut with a spade; but where it is hard or full of stones, the mattock or pick must be made use of. The tools used for hollow-draining, according to the Essex system, are extremely ingenious and appropriate for that purpose. Various sorts of draining ploughs have been invented, which, being of a complicated construction, have seldom been used with advantage. The *mole plough*, as it is called, is likely to be of service in draining soils free from stones; and is found to be particularly useful in pasture land. These implements shall be more fully discussed when the subject of draining is treated of [211].

10. *Rollers.*

The roller is the most valuable implement, for breaking hard clods expeditiously, and smoothing the surface of the land when in tillage, ever yet invented. It is likewise of use to grass lands laid down for hay; and heavy rollers would prevent those ant hills, by which so many pastures are deformed [212]. Rollers are made of various substances; as wood, freestone, granite or cast-iron; but on the whole, the two latter are to be preferred. It is of importance, that the weight of the roller, should be in proportion to the extent of surface on which it rests, and the nature of the land on which it is to operate. The best plan is, that of having two rollers, each about two feet and a half in length, and both placed in one frame, so as to roll clear of one another. This is the most suitable both for corn crops and sown grass, as it neither tears up the tender soil, nor injures the young plants, and also acts better, when any inequalities are to be met with on the surface. Besides, the labour in turning is much less severe on the frame, and on the cattle. Every farm ought to be provided with rollers of different diameters and weights, so as to suit the various purposes for which they are destined. Those of a small diameter, are generally applied to land in tillage; and those of a large diameter, with double shafts, to grass land. Heavy rollers are of great use for destroying worms, slugs, and other vermin in the soil (213). When rollers are of large diameter, they roll easily, and smooth the surface of the ground. But when they are made of stone, and of small diameter, they do not easily turn, but break the ground, and injure the herbage when dragged along. Hollow cylinders of cast iron, 3½ feet diameter, make the best of all rollers.

11. *Dairy Implements.*

The most essential implements for the dairy, are, Milk-dishes, Churns, and Cheese-shapes and Presses.

1. A number of articles have been used for holding milk, as wood, stone-ware, slate and lead, but none of them can be compared to those made of cast-iron, lately invented. They are softened by annealing in charcoal, turned smooth inside, and then laid over with a coat of tin, to prevent the milk from coming in contact with the iron, the rust of which might injure it. To prevent rust also, the outside of the dish is painted over. They are easily kept clean; and as they preserve a proper degree of coolness, the milk throws up more cream than in wooden dishes. Nor are they expensive; for a dish, to hold an English quart, only costs 1*s.* 2*d.* (214).

It is objected to earthen-ware dishes, that they are commonly glazed with the glass of lead, which the acid of milk very readily dissolves, and thus forms a compound of a most poisonous nature. But some consider this to be a refinement, as lead itself has been used for ages, (and still is in Cambridgeshire, Lincolnshire, &c.), without any perceptible ill effect; and milk seldom stands to be sour.

2. A variety of churns are in use. Of these, the sort shaped like a barrel is much approved of, being simple, easily wrought, and capable of being made of greater or less dimensions, according to the extent of the dairy. Others recommend a churn, somewhat in the shape of a cradle, but on a frame of wood. It is rocked regularly, not faster than the pendulum of a clock; and answers the purpose of making butter uncommonly well (215).

3. In the manufacture of cheese, the shape, (called a *vat*), and the press, are important articles. The best kind of

shape is that made of cast-iron; and the kind of press most esteemed is, that which is made of granite. Large hewn stones lifted by a screw, are advantageously used for pressing cheese ([216]). Cheese-presses in Scotland, are now constructed with levers and a double wheel, which stand in the space that an elbow chair would occupy. And they are so easily managed, that a boy or girl of fourteen years of age can put them in operation, provided they can put in and take out the cheese. Heavy stones raised by screws are now given up.

12. *Miscellaneous Articles.*

A variety of small implements for the barn, for the stables, and for the other offices, are necessary, but do not require any particular enumeration. There are four machines, however, of greater importance than the rest, and of them some account may be given: 1. The straw-cutter; 2. The turnip-slicer; 3. The bruising machine for beans, pease, or oats; and 4. The weighing engine.

1. Machines for cutting straw or hay, are certainly of use in preventing waste, and preparing coarse food, as straw, for horses or cattle. These machines, till of late, were separate, and the work was executed by manual labour; but the purposes of the cutter are more effectually accomplished, when it is annexed to any machine, as a thrashing-mill driven by water, by wind, or by cattle.

2. Machines have also been invented for slicing turnips or potatoes, to be given to stock. In regard to the latter, however, steaming, boiling, or baking ([217]), seems to be preferable. There is something injurious in the juices of the potatoe in a raw state, which cooking eradicates, or great heat neutralizes or dispels. How far the increased value of the steamed food, will compensate for the expense, has not yet been ascertained.

3. Bruising beans, pease, or oats, for the feeding of horses, is a practice much to be recommended; it having been found by experience, that by feeding horses with bruised grain, seven bushels will go at least as far as eight of the same quality given whole ([218]). This saving is at all times an object of importance, but more especially in times of scarcity.

4. A weighing machine is certainly, to farmers, an expensive article; but where it can be afforded, it is of much consequence, more especially to those who fatten stock. Indeed without it, no farmer can ascertain the progressive

weight of any particular animal which he feeds;—nor the value of the articles that he uses;—nor the return that stock make for their food. It is otherwise all guess-work; and many vague assertions have been circulated as truths, which have afterwards been found erroneous, when the experiments were made with accuracy ([219]).

A variety of other machines are to be found in the possession of agricultural societies, who very properly patronise every new invention that promises to be useful, though few of them can be employed by the farmer with real profit. Indeed, when these machines are complicated, though they may succeed in the hands of an ingenious artist, yet they can seldom be used with advantage by the ordinary class of labourers.

There are four additional points which remain to be considered on the subject of implements: 1. The materials of which they ought to be made; 2. The means of repairing and preserving them; 3. The propriety of introducing new implements in a district; and, 4. The means of improving their construction.

1. Agricultural machines were formerly made almost entirely of wood; but now, in many instances, they are constructed either in whole, or in part, of hammered, or of cast iron. The rapid extension of the great improvements made in the plough by Small, were chiefly owing to his getting a mould-board ([220]), and other parts of his plough, cast in iron, from patterns in wood; and plough-makers being thus furnished, with an approved model of the most difficult parts of the plough, were soon enabled to put the rest together, and to spread the same improved instrument all over Scotland ([221]). The use of iron, will probably, in many other instances, supersede that of wood. It is peculiarly well calculated for hot and dry climates, being inaccessible to the attacks of insects. It may indeed, be observed, that though implements in constant use, may be made either totally, or partly of wood, those which are only occasionally employed, should, if possible, be made of iron, as, when the season is over, they are apt to be negligently laid by, and if made of wood, suffer much injury ([222]).

2. Every careful farmer, will lay it down as a rule, to have an inventory of all his implements, and other articles therewith connected; and frequently to inspect them, so that when any part of them is observed to be in the least damaged, or in danger of giving way, it may be immediately repaired. An implement, likewise, that is not longer want-

ed during the season, ought not only to be carefully laid up; but before it is put aside, it should be well cleaned, rendered perfectly dry, oiled, or, if made of iron, painted, and kept so as to be ready for use when wanted. No circumstance marks more the character of an attentive husbandman, than great attention to his farming implements. Upon every farm, also, there ought to be one or more places, properly constructed, for holding the larger implements; and some secure place allotted, for containing the smaller tools. Where machines are necessarily exposed in the field, a great part of the season, they require to be new painted, at least every second year. This defends them, not only from drought, but also from rain and rust (223).

3. The introduction of new implements into a district, is often a matter of great difficulty, partly owing to the ignorance, the prejudices, and the obstinacy of farm servants and labourers, and partly to the prejudice against new inventions, from the number which are continually failing. Many farmers, therefore, very absurdly retain their old implements, though convinced of their inferiority, rather than sour the temper of the labourers, by attempting to introduce new ones. In several cases, however, by attention, perseverance, and by rewarding those servants who have been induced to give the new machines a fair trial, they have succeeded in the attempt.

4. The importance of proper implements is such, that the melioration of those in use, would be an essential advantage to agriculture; and great as are the mechanical improvements which have been already made, many of them are capable of being brought to still greater perfection. Persons of genius and experience, therefore, ought to be encouraged to devote their time and attention to this important object; and to exert themselves, either in improving the various sorts of implements now in use, on scientific principles, or in inventing superior ones, as circumstances may require. The discovery of an useful implement, by which the labours of agriculture can be abridged, or brought to a still higher degree of perfection, and the expense of cultivation, at the same time, diminished, cannot be too much encouraged, as likely to prove of essential service, both to the farmer, and to the public. It is calculated indeed, that an immense advantage would accrue, from even *the general adoption* of the improved implements now in use in particular districts. Mr Curwen was of opinion, that the farmers in the southern counties of England, lose at the rate of L.25 per cent. by the

heavy carts and waggons they employ ([224]); and there can be no doubt, that the introduction of two-horse ploughs and thrashing-machines, where these implements are unknown, would lessen the expense of labour, to the amount of at least 10 per cent. *.

SECT. VIII.—*Farm-Buildings, and Cottages connected therewith.*

THE agricultural prosperity of a district depends, in a considerable degree, on the condition of farm-houses and offices, and of the cottages in which the labourers reside. This cannot be too much inculcated. The health and happiness of those employed in husbandry require, that they should have a comfortable habitation to retire to, when their labours are over. In arable farms also, it is of much advantage, to have a set of substantial and well-arranged offices, adequate to the size of the farm, and suitable to the system of husbandry adopted in it, without which, the servants cannot do their work properly;—the cattle cannot be expected to thrive;—nor can any operation in husbandry be carried on with the same success, as when such accommodations are provided ([225]).

In discussing this subject, it is proposed briefly to consider;—The general principles on which agricultural buildings ought to be erected;—The situation of a farm-house and its offices;—The construction of the house itself;—The arrangement of the offices;—Their construction;—Out-buildings, where necessary;—The accommodations required by the farm-servants and labourers;—By whom the farm-buildings ought to be erected;—How they ought to be kept in repair;—and, How insured.

1. *General rules for the construction of Farm-Buildings.*—In constructing farm-buildings, the following rules ought to be attended to.

Though a circle contains most space, within the smallest possible inclosure, yet, with few exceptions, it is the least adapted for subdivision, and the most expensive in execution; while the square and the parallelogram, will be found the least costly, and the most commodious.

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* The proposed discussion on trenching land, and the spade husbandry, shall be printed in Chap. 4, Part 3, immediately after the sections on the cultivation of arable land, and the rotation of crops.

In low buildings, where the roof and joisting are the most expensive articles, the oblong form will be preferable, particularly when such a form is, in other respects, best adapted to the purposes required.

The cheapest buildings are those whose plan is contained within four straight lines. All projections add considerably to the expense, by the extra corners, breaks in the roof, &c. (225).

To prevent as much as possible the spreading of fire, it is highly important, to have all the cross division walls in any range of buildings, carried up through the roof, and coped above the covering. The doors of the house,—of the stables,—and other offices, should open outward. It gives much more room in the house, and in case of fire, the furniture is more readily removed, and the horses and cattle more easily got out, and saved from injury.

Farm-buildings should be planned according to the size, and the produce of the farm. Grazing and hay farms need few offices; a dairy farm requires more; while an arable one, notwithstanding the invention of the thrashing-mill, which contributes to render many large barns unnecessary, must have very extensive accommodations. The cow-houses should be so large, that the cattle may be tied singly. This is a great improvement, and the expense will not probably cost above a shilling or two additional for each animal. When stalls are made to hold two cattle, they are obliged to rest always on one side, whereas in single stalls, they may lie on either side, and without any fear of annoyance from their neighbours.

Although in buildings of an agricultural description, economy in their execution is an essential point, yet in their construction, a person of taste and judgment, will always endeavour to arrange them, so as to give them a good appearance.

2. *Situation of the house and offices.*—The first object, when a new set of farm-buildings is to be erected, is to fix on a proper situation, which ought to be as nearly as possible in the centre of the farm, more especially if it be arable. Nothing can be more preposterous, than to continue the old system, of having the farm-houses placed in villages, totally detached from the farm; a plan which originated, from the want of domestic security in feudal times, or the dread of foreign invasion. In many cases, a central situation, according to the size of the farm, and other local circumstances, makes a very considerable difference in point

of rent. Indeed, if the houses and offices are placed at the corner of a large farm, a part of the land will probably be neglected;—less manure will be sent to it;—the expense of cultivation will be materially increased;—the strength of the horses will uselessly be wasted in going backwards and forwards;—and the remote parts of the farm, will be left in a state of miserable pasturage; or, when occasionally broken up, the crops will necessarily be inferior to what they would have been, under a different system ([227]).

It is sometimes assigned as a reason, for not having the farm-houses and offices in a central situation, that at another part of the farm, a better command of water can be procured, for family use, and for the farm stock, or for driving a thrashing-mill, by which a great saving in the labour of horses is secured. That, however, is only an exception to the general rule, for it may be laid down as an axiom, "That the farm-house and offices ought to be placed, as nearly as possible, in the centre of a farm." Even if water be deficient, it may usually be obtained, by various contrivances to be afterwards explained, (see Sect. IX.); and in general, any difficulty of this kind, may be overcome, upon a large estate, by a new arrangement of the farm.

Where the circumstances of the case admit of it, the farm-house should front the south; for by this means it is less exposed to the cold northerly winds. The farm-stead should be placed on a well-aired and dry spot of ground, and, if it can be had, an elevated situation is always preferable. This is not only the most conducive to health, but affords an advantage of considerable importance, for it puts it in the power of the farmer, to see what is going forward in every direction ([228]). Where the house, on the other hand, is built in a low and humid spot, the crops of the occupier, however dry and well-conditioned when brought from the field, will soon acquire a softness, and perhaps mustiness, very injurious to their value ([229]). In erecting farm-houses in bleak climates, shelter at the same time, is not to be overlooked, for young stock thrive better in warm yards, than in exposed places; and in climates like ours, it is prudent, to guard as much as possible against tempests ([230]). The subject, of the advantage of having a command of water, shall be discussed in the following section.

3. *Construction of the farm-house.*—The propriety of having suitable accommodations for the farmer, his family, and his servants, in proportion to the rent he pays, need not be insisted upon. In the construction of the dwelling-house, uti-

PLAN of FARMS and FARM BUILDINGS.

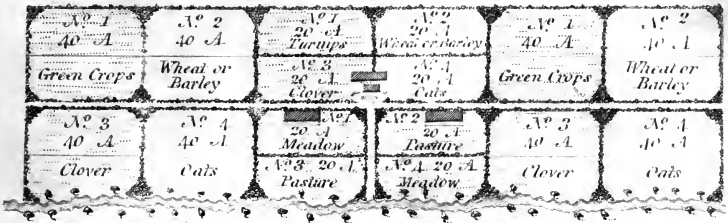
Plate 1.

No. 1.

Plan of a STRONG LOAM, OR A CLAY-LAND FARM of 300 Acres

No. 2.

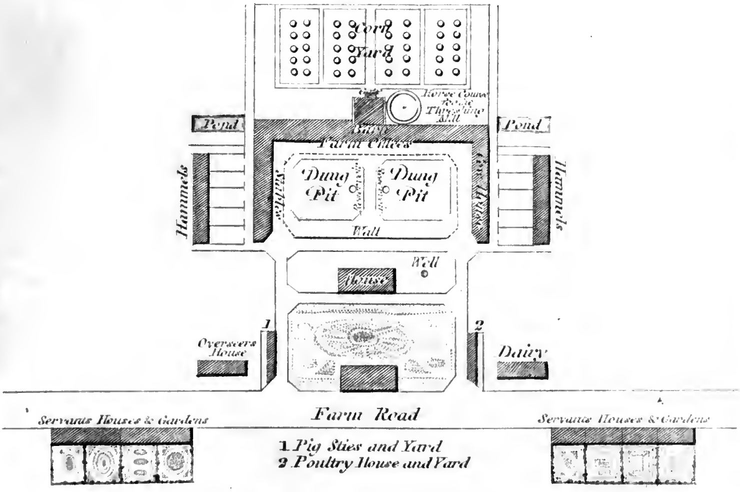
Plan of A TURNIP LAND FARM of 480 Acres.



The above are the most profitable systems of rotation, either in Strong Land, or in Turnip Land Farms, but where the Land is not rich, nor in the immediate neighbourhood of dung, it will be necessary to have one or two years pasture, after the Clover, to insure an abundant crop of Oats.

No. 3.

FARM HOUSE AND OFFICES.



The House may be situated in front of or behind the Garden, according to circumstances.

Neele sc. Strand.

lity, and not ornament, ought principally to be kept in view; Castellated farm-houses, for instance, are evidently absurd and incongruous. At the same time, every landlord of taste, in fixing on the site and plan of a new farm-house and offices, ought certainly not entirely to overlook the embellishment of the country. It is disputed, whether the house ought to have either wings, or a lean-to behind, or whether the whole should be under one roof. Many think that a house of three stories, the kitchen half sunk, is the driest, the cheapest, and the most convenient. Others prefer, having the kitchen in a wing, attached to the house, which, on the whole, is to be recommended ([231]).

A farm-house ought not only to be convenient, but should have such a degree of neatness and uniformity, that an idea of comfort and happiness may be given. It should have a little plot of garden ground or shrubbery either before or behind it. In the latter case, it is placed more distant from the effluvia of the dunghill. In the former, the offices, servants, and cattle, are more immediately in sight. The windows should be large, and the sashes should be placed rather nearer the outside of the wall than is usual; because, if wet, they will, in that case, sooner become dry. The house should be at a moderate distance from the offices, not only for the sake of purer air, but that the risk of setting the offices on fire, by sparks from the chimnies of the house, may be avoided ([232]). This is another argument for having the garden between the house and the farm-yard.

4. *Arrangement of the offices.*—The proper arrangement of farm-offices, when first built, is of essential consequence, for any blunder committed in this respect, can seldom afterwards be remedied. Peculiarities in the situation, such as a run of water for turning a thrashing-mill, declivity of ground, &c. will occasion a variety in the arrangement; but that set of offices can alone be said to be laid out to the best advantage, where the buildings are so placed, as to carry on the business of the farm in the most economical manner. Thus, easy access from the stack-yard to the barn;—from the barn to the granary;—the proximity of the straw-house, and turnip store-room, to the feeding-houses, straw-yards, &c.;—a ready access from the road to the cart-sheds, farm-stables, and other offices;—together with proper shelter and exposure, constitute the chief requisites in the arrangement. By arranging the offices properly, more labour can be obtained from the servants, while every operation on the farm, is carried on with more facility and dispatch.

5. *Construction of the offices.*—Nothing is more injudicious, than to have farm-buildings huddled together, round so small an area as from 60 to 70 feet. Where a farm contains from 300 to 600 acres, the area of the offices should not be less than from 100 to 150 feet square, formed into divisions, that the stock kept may be more equally fed. If it be found expensive to surround the square with buildings, a simple wall may afford shelter, till it is found convenient to enlarge the farm-yard. In fact, none but a practical farmer, who has had a large crop, and a number of cattle maintained during the winter, and who has seen the farm-servants carelessly driving the cattle and carts in confined court-yards, can fully appreciate the advantages of having his offices with a large area.

Though farm-offices should afford ample convenience to the occupier for carrying on his business, yet all superfluous buildings ought to be cautiously avoided. Those enormous barns, usually attached to many English farms, are on that account exceptionable; for grain in the straw, keeps infinitely better in the open air, than in close barns; and when it is put in stacks, it is less apt to be destroyed by vermin, —there is less risk of fire doing great damage,—and the expense of repairing, as well as constructing great barns, is saved ([233]). Thrashing-mills, when generally introduced, will render the erecting, and the supporting such buildings unnecessary.

6. *Out-buildings.*—In large farms, cattle-sheds, and other buildings, are often necessary at a distance from the house. The carting of green crops to the central set of offices, and conveying back the manure to remote fields, are attended with such inconvenience, and such ruinous expenses, that it is highly expedient, to have cattle-sheds dispersed over every part of an extensive occupation, and sometimes even extra barns are requisite.

7. *Accommodation for farm-servants and labourers.*—The habitations of labourers employed in husbandry, consist either of cottages attached to farms, for the accommodation of the servants employed in them, or the houses of day-labourers. They constitute a description of buildings peculiarly interesting, from their belonging to such valuable classes of the community. Their windows should be of cast-iron, of the lozenge shape, as the cottager can easily learn to put in himself panes of that form when any are broken, and the expense will not probably exceed 2d. each. Where pigs are kept, the sty should be neatly thatched, for the sake

of warmth, and the door should be so high, as to admit a man easily.

In regard to the houses of farm-servants, they should be situated at a convenient distance from the offices, and have a small garden attached to each of them. In the improved districts of Scotland, married servants are commonly permitted to have cows and pigs; and where their cows are not kept with those of their master, in the cow-house of the farm, sheds are placed for them, either against the back wall, or at the end of the range of cottages where these servants reside (234). The cottages of day-labourers in Scotland, are of a similar description with those of the farmer's servants; but in England, they are often constructed with peculiar neatness and attention.

Cottages are built either with two floors, or with only one. The former mode is very general in England, the latter is more prevalent in Scotland, cottages with a single floor being supposed warmer, and less liable to have the roofs damaged by the violent winds so frequent in that country.

For the sake of economy, cottages are usually erected in a line, by which mode, one gable answers for two cottages. The inhabitants of cottages, also, when they are contiguous, can furnish assistance to each other, in cases of accident or sickness.

Wherever there are quarries of thin flat stones (235), and materials for common roofs are dear, cottages with arched roofs have been recommended (236). They are not only dry, warm, and comfortable, but, when once erected, likely to last for many years (237). Where slates cannot be obtained at a low price, a coat of Roman cement, plastered over the arched roof, will preserve the building equally dry and durable (238).

Where cottages have upper chambers, and thin roofs of tile or slate, they are so excessively hot in summer, and so very cold in winter, as to be scarcely habitable. If there are upper chambers therefore, some are inclined to prefer a thatched roof (239). Were it not for the tax on bricks, arched roofs might be made of them, at a moderate expense, and not liable to any particular objection.

8. *By whom farm-buildings ought to be erected.*—The value of an estate is so considerably augmented by commodious buildings, that the owner, who has a permanent interest in the soil, ought to be at the expense of making so substantial an improvement. But this cannot in some cases be effected, where the estate is entailed, and the owner

has only a life-interest in the property. Sometimes the tenant has a greater command of ready money than the landlord, and he generally can lay it out with more economy, and to more advantage. In such a case, it may be advisable for both parties to arrange a plan, by which the buildings are to be erected at the expense of the tenant, the farm being let at a rent proportionably lower, according to the extent of the buildings required. In other cases, when the tenant undertakes the construction of the farm-buildings, the landlord agrees to make an allowance off the first, the second, and in some cases, even the third year's rent, for that purpose.

Many an industrious farmer however, has got the character of being a bad husbandman, from having been unguardedly led, to exhaust his capital so much on buildings, as to disable him from applying an adequate proportion of it, to the purchase of proper stock, or to the cultivation of the soil. And it may be laid down as a maxim, that though a farmer is well entitled to accommodations, in proportion to the size and produce of his farm, yet to erect these, on a larger scale than circumstances require, is wasteful prodigality. Above all, increasing the expense, by making ornamental erections, cannot be too cautiously avoided. It ought to be considered, that the repair of buildings upon a farm, is a heavy burden upon an occupier during his lease, and especially at its conclusion, when he is necessarily obliged to put the whole in a good condition. A farmer, without doubt, is entitled to comfortable and convenient buildings, if they are not upon the premises when he enters into the farm; but in their erection, a prudent economy ought never to be neglected ([240]).

9. *By whom the farm-houses and offices ought to be kept in repair.*—The repairs may be done, 1. By the landlord; 2. By the tenant; or, 3. At their joint expense.

1. When the landlord is to support the buildings, there is often too little attention paid by the tenant to trifling repairs, which would frequently save much greater charges afterwards. When they are chiefly done at the cost of the landlord, they are estimated, on an average, at 10 per cent. of the rent, including materials ([241]). They are in some cases, however, so enormous, that on one estate, where the rent was L. 15,000 a-year, they amounted, in eleven years, to L. 40,000 ([242]).

2. The repairs of farm-houses and offices, in the greater part of Scotland, are usually done by the tenant ([243]). It is

a great addition to the incomes of the Scotch proprietors, to be exonerated from so heavy a charge, and it is not found to be attended with any material loss to the tenant. The buildings, at least in the more improved districts of Scotland, are, in general, substantial, which the climate renders necessary; and the materials being good, the houses are more easily kept in repair.

In Ireland, very little attention has hitherto been paid to render farm-houses or offices either comfortable, or commodious. There are but few instances of landed proprietors having made any allowance for improvements, and much fewer, of the tenant being remunerated for any necessary or useful expenditure. The tenant is thus incapacitated from turning his farm to the greatest profit, when he is obliged to expend, perhaps, a large part of his capital, in a manner unconnected with the improvement of the soil ([244]).

3. Some persons think, that the tenant should be at half the expenses of workmen's wages, (which would interest him in the preservation of the buildings), and that the landlord should furnish materials, and be at the remainder of the expense ([245]). Others recommend, that the materials should be provided, and the repairs done by the tenant, at the joint and equal expense of himself and his landlord. It is rather more usual for the landlord, to put the buildings into a proper state of repair, at the tenant's entry; and for the tenant, (who is frequently furnished with rough timber for that purpose), to leave them in that state at his departure.

The engraving (No. I.) will give *a general idea* of the arrangement best calculated for the interest of the farmer, in regard to his house, gardens, cottages for his farm-servants, farm-offices, and stack-yard. To enter into details, would far exceed the limited size of this publication.

10. *Insurance of farm-buildings.*—This is a material object both for the landlord and tenant; and a stipulation to that effect ought to be inserted in every lease. As it is attended with trouble and expense to the tenant, to be annually going to insurance offices, it is better that the landlord should insure all the buildings on his estate, which might be included in one general policy, and probably at a cheaper rate. Means should also be taken, to preserve the buildings from the effects of lightning ([246]).

Sect. IX.—*Command of Water.*

Those who have a command of good water, can have no conception of the miseries which attend the want of it; or which are experienced, when this necessary article, can only be had in small quantities, or of inferior quality. In the low districts of Lincolnshire, the water is almost every where brackish, and good river or spring-water, is in such request, that carts are sent for it, in some cases, as far as even sixteen or seventeen miles ([247]). In the Wolds of Yorkshire, there are instances still in recollection, before the improved mode of making artificial ponds was discovered, of numbers of animals having perished of thirst ([248]); and in Hampshire, from the long continuance of dry weather during the autumnal months, the wells became so exhausted, that great labour and expense were incurred, in supplying the family and the stock, by means of water-carts ([249]). To avoid the risk of such serious misfortunes, it was anciently the practice, for the conveniency of having water, to erect farm-buildings in low grounds, near brooks or rivers. This plan, however, was attended with several disadvantages. The house became damp; the grain, from the moisture of the atmosphere, was frequently injured, and, from the vicinity of the water, accidents of various descriptions frequently occurred ([250]). When the advantages, therefore, of having a house and offices in the centre of the farm, and rather on an elevated situation, came to be generally understood and admitted, various modes of obtaining a supply of so essential an article as water, were devised. The chief are, 1. From the roofs of the buildings; 2. Natural springs; 3. Wells; 4. Artificial ponds; or 5. Artificial rills.

1. *Roofs of buildings.*—Water for common purposes, may be obtained in most situations, by collecting the rain which falls upon the buildings occupied by the family and their cattle; and the means of freeing it from every impurity, are simple and easy ([251]). The buildings and yards of a farm, are supposed to receive rain sufficient, if duly collected, to supply both the family and the cattle of the place, for a considerable part of the year; and ponds, where necessary, may be made in any situation, at a very small expense, for the remainder. Cattle, therefore, ought not to be driven to water beyond the limits of their pasture; and it is not requisite to fetch water in carts from distant places ([252]).

2. *Natural springs.*—Where natural springs are to be met

with, they will generally furnish a sufficient supply for family use; but they are seldom adequate to the necessities of a great farming establishment. If sufficient attention, therefore, has not been paid to the collecting of water from the roofs of the farm-buildings, wells or ponds must be resorted to ([253]).

3. *Wells.*—In Middlesex and Surrey, they have dug wells to a considerable depth, (from 100 to above 560 feet), before they could procure water ([254]). In Essex they have been obliged to go as deep as 500 feet, to obtain water of a good quality, and, at that depth, they succeeded. In Hampshire they have likewise dug from 300 to 400 feet in depth, through dry, cracked, or fissured chalk rock, and thus have been able to supply whole villages with water, except during the autumnal droughts ([255]).

4. *Artificial ponds.*—In several parts of England, as in Hampshire, in Lincolnshire, and in Norfolk ([256]), artificial ponds have been formed with varied skill and success. In Gloucestershire, such ponds are made, either of a square or a circular shape, and generally so situated, as to furnish a supply to four fields. Three layers of clay, free from the smallest stone or gravel, are so worked in, as to form an impenetrable cement. The whole is afterwards covered with sand, and finished with pavement ([257]). In Derbyshire, artificial *meers*, or cattle ponds, are made in their dry rocky pastures, with great success. Having selected a low situation for the purpose, they deepen it ten or twenty yards across, and spread over the whole excavation a layer, about five inches thick, of refuse, slacked lime and coal cinders; then they spread, trample and ram down, a stratum of well-tempered clay, about four inches thick; and upon this they place a second bed of clay, in a similar manner, of the same thickness; the whole of the bottom and edges of the meer is then paved with rubble stones; and small rubble stones, several inches in diameter, are spread upon the pavement ([258]).

A most ingenious, as well as economical mode of making reservoirs of water, was invented about the year 1775, by Robert Gardener, a well-sinker by profession, born at Kilham, in the East Riding of Yorkshire. Prior to the introduction of his plan of making artificial ponds, many parts of the Yorkshire Wolds were scarcely habitable. But by the ingenuity and exertions of one individual, the difficulties which lay in the way of the improvement of an extensive district, have been removed ([259]). They are now universally to be met with in the East Riding, and are widely extended into the North Riding, in situations that require such accommodations (260). A description of this useful discovery will be given in the Appendix, No. XI.

Ponds are much more eligible than wells for watering stock, the water being considered more wholesome, and much labour being saved. Few servants like the trouble of drawing water from wells. When stock, therefore, depend upon water from wells, they are likely to have too much water at one time, and to be ill supplied at another. Ponds for stock, are best situated on elevated situations, being then less apt to be injured by dirt running into them (261).

5. *Artificial rills.*—In the North Riding of Yorkshire there is a tract, extending for many miles, entirely destitute of water, except what flows along the bottoms of the deep valleys by which it is intersected, and little relief could consequently be afforded by streams thus distantly and inconveniently situated, to the inhabitants of the uplands, or their cattle. About the year 1770, a person of the name of Ford, devised the means of watering this district, by means of rills brought from the springs that break out at the foot of the still loftier moorland hills, which run parallel to, and to the north of this tract, in some instances at the distance of about ten miles.

These springs he collected into one channel, which he carried, in a winding direction, about the intervening tract, according to its level, and along the sides of the valleys, until he gained the summit of the arid country, which he wished to supply with water; and when this was accomplished, the water was easily conveyed to the places desired, and also to the ponds in all the fields over a considerable tract of ground.

The plan of thus watering a dry upland country, has much merit. It is not expensive, the original charge rarely exceeding L.100 per rill, while it affords a most important accommodation to the occupier, and the value of the property is thereby greatly increased. Though not generally applicable, this plan might certainly be adopted with great advantage, in some situations (262).

It remains to state, how farm-yards and fields may best be supplied with water, in the abundance that is necessary.

Water in farm-yards.—When cattle are fed in winter on dry food, as hay or straw, no expense should be spared in supplying them with a sufficient quantity of water. It has been ascertained, that a bullock feeding upon straw, having water at command, will drink of it eight times a-day; hence it is evident, that he cannot get enough, if only driven twice a-day to an adjoining stream or pond. It is therefore advisable, where it can be done, to bring water into a cistern in the fold-yard, to which the cattle may go whenever they are in want of it. The cistern may be made of rough masonry, and consequently would not be expensive. There can be no doubt, that cattle will improve much more rapidly, more especially on coarse fare, when thus supplied with water, than if they were only occasionally driven to it ([263]).

In Derbyshire, cisterns hewn out of large blocks, are not only placed in most cattle yards, but also in the fields where the springs on the sides of the hills admit of supplying them. Many of them are so placed, that cattle can approach them on either side, and can avoid being injured by a master beast attacking the others when drinking. For conveying the water to the cisterns, thin *zinc* pipes are sometimes used, as being cheaper. When the water enters at one end of the cistern level with the surface, and passes off at the other, from the constant change and agitation of the surface of the water, by this stream across it, the cistern is not so apt to be frozen, even in the severest weather, which is an object of much importance to the health of the cattle ([264]).

Fields.—A supply of water is also an object of great importance, in every field where pasturage is intended. With that view, if there happens to be a small rivulet in the neighbourhood of the lands, it may often be distributed in branches, so as to water many fields. Springs, or the collected discharges from drains, may also be applied to the same purpose. All land used for grazing requires to be constantly well supplied with water.

In conducting water through fields, it is of material importance to take care, that the slopes be gentle, and not more than sufficient for easy transmission; as, when water is conveyed down fence ditches, or open conduits of considerable declivity, it is too apt to do injury in its progress, by washing away the sides of its channels. Sometimes water is collected in a field, not only for the use of the animals pastured there, but also to be afterwards diverted for various uses, as for thrashing and other mills,—irrigation,—and ponds for bleaching and similar purposes. To accomplish these objects, and at the same time to prevent injury from this element, the drains, conduits, sluices, bridges, gates, and fence ditches, require to be designed with skill, and constructed with scientific attention.

Sect. X.—*Size and Shape of Fields.*

It is of great advantage to the occupier, when his fields are of a proper size and shape; and a loss must inevitably follow, when they are laid out arbitrarily, without attention to any particular system. Where a whole farm is divided into fields of various sizes, it is difficult to form a plan, so as to suit a regular rotation of crops, or to keep very accurate accounts. Whereas, by having the fields *in general* of a large size, the whole strength of a farm, and the whole attention of the farmer, is directed to one point; while an emulation is excited among the ploughmen, when they are thus placed in circumstances which admit their work to be compared. Some moderate-sized fields are certainly convenient on any farm, for grazing, and other purposes to be afterwards explained. On elevated situations also, the shelter derived from small inclosures, is of use.

Nothing, however, is more inconvenient, in corn farms, than to have a number of small inclosures, irregularly shaped, surrounded with trees or high hedges, more especially in a flat country, where shelter is unnecessary. Besides the original expense of making the inclosures,—the injury done to the crops of grain, produced by the want of a free circulation of air,—and the shelter afforded to numbers of small birds,—the very site of numerous hedges, with their attendant ditches,—and the uncultivated slips of land on both sides of them, consume a much larger proportion of arable land than is commonly imagined. Hedges, especially if accompanied by rows of trees, greatly exhaust the ground of its fertility; nourish weeds, the seeds of which may be widely disseminated; and by excluding the air, cause the harvesting of the crop to be carried on more slowly. Even upon meadow land, small inclosures, encircled by hedges, are injurious, as they prevent the circulation of air necessary for making or drying hay. Small inclosures, with high hedges and trees, are also extremely injurious to the roads in their neighbourhood.

On the other hand, with fields of a considerable size, less ground is wasted, and fewer fences are to uphold. The crops of grain, being more exposed to wind, can be harvested earlier, and they suffer less from damp seasons. Small inclosures in pasture, are most productive in winter, being better sheltered; but in summer, the larger and the more open the inclosures are, the better; for in hot weather, both cattle and sheep always resort to the most airy places. It is easier also, when they are in pasture, to obtain supply of water in large fields than in small ones: indeed fields are sometimes so small, that it is very difficult to procure an adequate supply of water, even in winter. But the conclusive argument in favour of large arable fields is this; that where fields are small, much time and labour are wasted by short turnings; and it is now ascertained, "that if fields are of a regular shape, and the ridges of a proper length, five ploughs may do as much work in them, as six ploughs in fields of a small size, and of an irregular shape; while every other branch of labour, (such as dunging, sowing, harrowing, reaping, and carrying in the harvest), can be executed, though not altogether, yet nearly in the same proportion ([365])."

The circumstances on which the size of fields ought to depend, are;—the extent of the farm in which they are situated;—the nature of the soil and subsoil;—the rotations adopted;—the number of ploughs on the farm;—the inclination of the ground;—its being in pasturage or otherwise; and—the nature of the climate.

1. *Extent of the Farm.*—The size of fields ought certainly, in some measure, to depend upon the extent of the possession. In small farms, near towns, from six to twelve acres may be sufficient; but where farms are of a considerable extent, fields from twenty to even forty acres, and in some particular cases, as high as fifty, may be used to advantage. In general, however, even on large farms, when local circumstances are favourable, fields of a medium size, as from fifteen to twenty-five English acres, are recommended by competent judges.

2. *Soil and Subsoil.*—In dividing a farm into fields, the nature of the soil and subsoil ought to be kept in view. Where the soil is various, it would be proper to separate the light from the heavy. They are not only better calculated for different crops, and different rotations, but are naturally adapted to be cultivated at different seasons. It is unfortunate, therefore, to have soils of a heterogeneous nature, mingled in the same field. But where this partially takes place, for instance, where there are only one or two acres of light soil, to ten or twenty of strong soil, let the following plan be adopted. At any slack time, either in summer or winter, more especially when the field is under fallow, employ two carts and horses, with four fillers, to cover the

acre or two of light soil, with the strong soil contiguous, and the soil in the field will then become more uniform. In fields where light soils predominate, the plan might be reversed. This plan, though at first expensive, is attended with such advantages, that whenever it is necessary and practicable, it ought to be carried into effect.

3. *The Rotation adopted.*—It may be considered as a good general rule, to divide a farm, according to the course of crops pursued in it; that is to say, a farm with a rotation of six crops, should have six fields, or twelve, according to circumstances. It is proper to have a whole field, if the soil be uniform, under one crop; and every farmer of experience, knows the comfort of having the produce of the farm, as equal every year, as the soil and season will admit of.

4. *Number of Ploughs.*—It is likewise proper, that the size of fields should be somewhat in proportion to the number of horses and ploughs on the farm. For instance, where six two-horse ploughs are kept, and where it is difficult, from the nature of the soil, to have the fields of a larger extent, sufficiently dry, from 18 to 25 English acres are considered to be a convenient size. With twelve horses, a field of that extent can always be finished in four, or at the utmost, in five days: there is less risk therefore of being overtaken by bad weather, and prevented from completing the preparation of the land for the intended crop. When the fields are of too great an extent, in proportion to the stock kept, a considerable interval must occur between the sowing of the first and of the last part; and it will in general be desirable to have each field cleared at the same time in harvest. The harrowing also is done more economically, when the field is sown at once, than when sown in several portions; and where rolling is required, that operation being most effectually done across, it cannot well be accomplished till the whole field has been completed. Hence the advantages of having the size of the fields, in some degree commensurate to the stock of working animals upon the farm.

5. *Inclination of the ground.*—It is, however, evident, that the size of the fields, must in some respects depend on the flatness, or the hilly shape of the ground. Even on dry land, if there be a rise on the ground, from fifteen to twenty chains is sufficient length; for if the ridge be longer, the horses become much fatigued, if compelled to plough a strong furrow up-hill, beyond that length, in one direction. This objection, however, to large fields, may in some measure be obviated, by giving the ridges and furrows, in such

fields as are on the side of a hill, such an obliquity, as may diminish the difficulties of the ascent ([366]).

6. *Pasturage.*—Where the system of grazing and tillage is alternately followed, (more especially where the fields are pastured for two or three years in succession), it is convenient, to have the fields of from 20 to perhaps 30 English acres. The farmer is thus enabled to divide his stock, which he cannot well do with larger fields. The cattle or sheep remain more quiet, than if a greater number were collected together; and less grass is destroyed by treading. When such a field has been pastured for some time, the stock should be removed to another, till the grass in the former has been renewed, and is fit for being eaten. Such a size also, in general, suits graziers better than larger ones; and consequently fields of this extent, when in pasture, generally let for more rent.

7. *Climate.*—The last circumstance to be considered, in determining the proper size of fields, is the nature of the climate. In dry and cold climates, small inclosures are desirable, on account of shelter; whereas in wet countries, the fields under culture, cannot be too open and airy, for the purpose of drying the ground, of bringing forward and ripening the grain, and of enabling the farmer more easily to secure it, during an unfavourable harvest, by having a free circulation of air.

But though on large farms, fields should in general be formed on an extensive scale, yet there is a convenience in having a few smaller fields near the farm-house, for keeping the family cows;—for turning out young horses, mares, and foals;—for raising a great variety of vegetables;—and for trying experiments on a small scale, which may afterwards be extended, if they should be found to answer.

Where inclosures are too large for particular purposes, and where no small fields, as above recommended, have been prepared, large fields may be subdivided by sheep hurdles, a sort of portable fence well known to every turnip grower. In this way, great advantage may be derived, from the constant use of land, that would otherwise have been occupied by stationary fences; and the expense of subdivisions, which, on a large farm, would necessarily have been numerous, is thereby avoided. This fence is perfectly effectual against sheep, though it is not so well calculated for stronger animals. On dry soils, where sheep are generally pastured, it is not unlikely, that by using moveable hurdles, the expense of permanent fences might in a great measure be saved.

Iron hurdles, some cast, and others much lighter, made of wrought iron, are also frequently used as temporary fences. If made for sheep, the cast metal is only 7*s.* each, but 9*s.* if strong enough for cattle ([367]).

The shape of fields may be either square or oblong.

Square form.—The advantage of having the fences in straight lines, and the fields, when large, of a square form, is unquestionable, as the ploughing of them, under this arrangement, can be carried on with much greater dispatch. Some farmers, whose fields are of a waving or uneven shape, and who inclose with hedge and ditch, carry their fence through the hollows, or best soil, with a view of raising a good hedge, thus often sacrificing, for the sake of the fence, the form of their field. A straight line however, is preferable, even though it should be necessary to take some particular pains to enrich the soil for the hedge, where it is thin and poor, on any elevation. By means of the square form, an opportunity is afforded, of ploughing in every direction, when necessary; and less time is lost, in carrying on all the operations of husbandry, in a field of that form, than of any other shape. Where the waving form is necessary to secure proper water-runs, plantations may be so disposed, as to reduce the fields to squares or oblongs, and the fences to straight lines. Rectangular fields have another advantage, that in fields of that shape, it may be known, whether the ploughmen have performed their duty, the quantity of work done being easily calculated, from the length and breadth of a certain number of ridges.

Oblong form.—When fields are small, an oblong shape should be preferred, that the ploughing may be dispatched with as few turnings as possible. This form has also other advantages. The fields are more easily subdivided, and water can almost in every case be got, by making proper ponds in the meeting or joining of three or four fields, whose gutters, or ditches, will convey water to the ponds. In turnip soils, where the shape is oblong, it is easier to divide the turnips with nets or hurdles, for the convenience of feeding them off with sheep. If the ridges are too long, and the field dry and level, the length may be reduced, by making cross head-lands, or head-ridges, at any place that may be considered the fittest by the occupier.

The same engraving, (No. I.) will likewise explain the best plan for dividing fields on clay land, and turnip-land farms, in square divisions, and the rotations that may be adopted in each.

Sect. XI.—*Farm Roads.*

The profitable occupation of a farm, is essentially promoted, by having the private roads through it, judiciously planned, well formed at first, and afterwards kept in proper repair. Attention to these particulars is often neglected, in consequence of which both the landlord and tenant sustain much injury. These private roads, like other substantial improvements, ought to be made at the expense of the landlord; but if he is unable to advance the money, the tenant ought to be encouraged to make the necessary exertions, by a premium for every yard he properly executes, or security given him, that he shall be indemnified, to a certain extent, at the termination of his lease.

Where the farm is regularly divided into large inclosures, it is seldom difficult to obtain the advantages of convenient roads, with easy access from the farm-offices, to each field; nor would the making of good roads in any case be difficult, provided a regular plan were adopted for that purpose; materials may be collected, and the stones broken by the farm-servants, at times, when, from the state of the ground, other operations could not be well executed; and if a rule were laid down, to make a certain quantity of road, from 50 to 500 yards, every year, according to the size of the occupation, the roads, even on a large farm, would thus be progressively gone over, and its value would be materially augmented.

It is particularly necessary, to make a good piece of road at the gate of every inclosure, that being the spot which is most frequently in use. Without this precaution, it often becomes a mire, where corn is thrown down and spoiled in harvest; or if it is attempted to avoid the mire, the gate-posts and neighbouring fence are often damaged ([368]).

In order to prevent accidents, it is necessary to have the gates wide, and whatever may be the sort of fence, *to round the corners of the fields*, instead of having them square. By this plan, owing to the facility of turning, many accidents, injurious both to the carts, and to the cattle, may be prevented.

The most effectual means, by which either public or private roads can be kept in good repair, is, by the use of broad *cylindrical* wheels, which are as well calculated for farming, as for other purposes. A gentleman who has given the experiment a fair trial, states, that no person, whose mind is open to conviction, can use these wheels, without at once perceiving, their very great superiority over the narrow conical ones. He is satisfied, that his farm roads will be maintained at one-fourth of the expense that had previously been incurred. In farming operations, their superiority is so great, that he thinks it would be for the advantage of every extensive farmer, to adopt them immediately. He considers them to be the greatest improvement in agricultural machinery, since the invention of the thrashing-mill; and he conceives, that every month's delay that takes place in their general adoption, is a great individual and national loss ([369]).

If a farmer be thus accommodated with good private roads, the advantages which result from them are of the highest importance. His work will be performed at much less expense;—the labour of the horses will be much easier;—a greater quantity or weight of grain, and other articles, may be more expeditiously carried over them;—manure can be more easily conveyed to the fields;—the harvest can be carried on more rapidly;—and wear and tear of every description will be greatly reduced ([370]).

It may be proper to add, that bringing a good *public road* throughout a farm, by which the conveyance of its productions on the one hand; and the procuring of manure from a neighbouring town on the other hand, is greatly facilitated, makes a difference of from 5*s.* to 7*s.* 6*d.* *per* acre, in the value of a farm.

Concluding Observations.

Such appear to be the most essential means, for carrying on the successful improvement and cultivation of a farm. It is by attention to these particulars, that a good, is distinguished from a bad farmer; and that the diligent husbandman, lays the foundation of a system, which will prove the source of his future prosperity. For that purpose, it is necessary for him,—to proportion his farm to the capital he can command;—to keep regular accounts;—to establish a judicious arrangement in the cultivation of his farm;—to procure intelligent and industrious labourers;—to rear, or to purchase well-selected stock;—to buy implements, distinguished more by utility than number;—to have his buildings well arranged, and abundantly supplied with water;—

and to divide his fields in a regular manner, with roads of communication to them, kept in a proper state of repair. If these particulars be attended to, he has every reason to look for success; but in proportion as they are neglected, he may expect to meet with disappointment, and in many cases to experience real loss.

CHAP. III.

ON THE VARIOUS MODES OF IMPROVING LAND.

The ingenuity of man has in no respect been more usefully employed, nor, on the whole, been displayed more conspicuously, than in the various modes it has discovered, for rendering the surface of the earth more productive. Not only have extensive tracts of waste land been reclaimed, but by processes about to be described, the culture of the soil has been improved;—the quantity of its produce augmented;—and the quality of that produce amended:—while, by the art of embanking, thousands of acres have been protected from the ravages of a powerful and destructive element. In this chapter, it is proposed to give a *general view*, of the nature of these several processes, under the following heads: 1. Cultivating and improving wastes; 2. Inclosing; 3. Draining; 4. Manuring; 5. Paring and burning; 6. Fallowing; 7. Weeding; 8. Irrigating; 9. Flooding; 10. Warping; and, 11. Embanking. Any discussion on the means of improving the soil *by planting*, is reserved for the fourth section of the subsequent chapter.

Sect. I.—*Cultivating and Improving Wastes.*

Land, when uncultivated, more especially in a climate like ours, yields but slender means of subsistence to man. Some fruits of little real value,—articles of the nut species—also, the leaves and roots of several plants, may be used as food. The numbers however, that could be maintained, either by these means, or by hunting wild animals fed on natural herbage, or by the flesh and produce of domesticated animals, maintained in the same manner, are but inconsiderable, compared to the millions of human beings, who enjoy the necessaries and comforts of life, when the soil is properly cultivated. The first object, therefore, to be attended to, in procuring food from the soil, is, to bring it into a state of cultivation; the next, not only to prevent it from being exhausted, but, if possible, to increase its fertility ([1]).

In discussing this subject, it is proposed to consider; 1. The various descriptions of waste lands; 2. The natural obstacles to cultivating and preparing them for the production of crops; 3. The various means of reclaiming such wastes; 4. The rules to be observed regarding this species of improvement; and, 5. The private and the public advantages to be derived from it.

1. *Of the various Descriptions of Waste Lands.*

These may be classed in the following manner: 1. Mountainous, hilly, or steep grounds; 2. Moors; 3. Bogs, or peat-mosses; 4. Marshes; 5. Warrens, or downs; and, 6. Shores, or beaches.

1. The highest peaks and ridges of mountains, are mostly naked primitive rocks, or volcanic productions. Their more elevated sides, and the tops of those of moderate height, are usually covered by a thin soil, producing a short dry herbage, which in Europe, is frequently mixed with a dwarf or stunted heath (2). Where the soil is not injured by moisture, these are best calculated for sheep. When the height of mountains exceeds 800 feet of elevation above the level of the sea, unless covered either with natural woods, or artificial plantations, they can only be profitably used, in the British Isles, as pasture.

The hills, or land less elevated than mountains, have, in general, a deeper and moister soil, and produce a more luxuriant herbage, but of a coarse quality; hence they are better adapted for small hardy cattle. Though the summits of hills are generally unfit for raising grain, yet the plough is gradually ascending along their sloping sides, and within the last thirty years, many thousand acres, in such situations, have been reclaimed in the United Kingdom.

Some steep lands along the sides of rivers, and small streams, still remain in a state of waste, being inaccessible to the plough, and unfit for tillage. The more rugged of these, are well calculated for woods or coppice; while those in more favourable situations and climates, may be converted into orchards (3).

2. Moor-lands are of various descriptions. Sometimes they are in low and mild situations, where the upper soil is thin, or scantily supplied with vegetable mould; and where the bottom, or under-stratum, is impervious and barren. These, in general, may be reclaimed with more or less advantage, according as they are near manure, or markets, and other means of improvement.

Others, on the contrary, are in situations much elevated above the level of the sea; where the surface is covered with heath, and other coarse plants, and frequently encumbered with stones. Such moors are seldom worth the expense of cultivation, and from their height, are only calculated, either for woods or pasturage.

Moors, however, which are not placed in high or bleak situations, and where the surface is close-swarded, or covered with plants, and where the subsoil is naturally, either not altogether wet, or capable of being made sufficiently dry at a moderate expense, may not only be reclaimed, but often can be highly improved. Indeed where such lands are to be met with, they ought on no account to be suffered to remain subject to commonable rights, and comparatively useless to the country, as they are capable of being reclaimed, and if allotted and inclosed, might be rendered highly productive.

3. Bogs, or peat-mosses, occupy no inconsiderable portion of the surface of the British Isles (4). They are of two sorts, one black and solid, the other spongy, containing a great quantity of water, with a proportion of fibrous materials.

Black mosses, though formerly considered irreclaimable, are now found capable of great melioration. By cultivation, they may be completely changed in their quality and appearance; and from a peaty become a soft vegetable earth, of great fertility. They may be converted into pasture;—or, after being thoroughly drained, thriving plantations may be raised upon them;—or, under judicious management, they will produce crops of grain and roots;—or, they may be formed into meadow land, of considerable value (5).

Flow, fluid, or spongy mosses, abound in various parts of the British Isles. Such mosses are sometimes from ten to twenty feet deep, and even more, but the average may be stated at from four to eight. In high situations, their improvement is attended with so much expense, and the returns are so scanty, that it is advisable to leave them in their original state; but where advantageously situated, it is now proved, that they may be profitably converted into arable land, or valuable meadow. If they are not too high above the level of the sea, arable crops may be successfully cultivated. Potatoes, and other green crops, where manure can be obtained, may likewise be raised on them with advantage (6).

Peat is certainly a production, capable of administering to the support of many valuable kinds of plants. But to effect this purpose, it must be reduced to such a state, either by the application of fire, or the influence of putrefaction, as may prepare it for their nourishment. In either of these ways, peat may be changed into a soil fit for the production of grass,—of herbs,—or of roots. The application of a proper quantity of lime, chalk, or marl, prepares it equally well for the production of corn. But in cases where peat is too wet for the production of fine grass or good corn, the first operation is, to drain it completely (7); and then to supply it with calcareous and putrescent manures.

4. Marshes, or water-fed lands, are of two descriptions, one formed by fresh, and the other by salt water.

Fresh water marshes are often found interspersed with arable land, where springs rise, and redundant water has not been carried off; and may be improved by a course of ditching, draining and ploughing. Where large inland marshes are almost constantly covered with water, or the soil is extremely wet, they may be drained, as large districts in the fens of Lincolnshire have been, and made highly valuable. The object in that case, is, by embankments, draining, and other means of improvement, to convert these marshes into pasture, or meadow, or even arable lands. Where such improvements cannot be accomplished, the most useful aquatic plants, as willows, osiers, &c. may be propagated, either by their seeds or roots, with much advantage to the cultivator (8). Some have strongly recommended, on such wet and low lands, the fiorin grass; others the "*poa aquatica*," which would answer well where the soil is clay, and where it lies under water all the winter.

In regard to salt water marshes, embankments are the only means by which they can be improved; and they might be rendered of thrice their present value, if spring tides could be prevented from overflowing them. They are in general deficient in quantity of pasture; and the herbage they produce, though nutritive, has a laxative effect, operating as a medicine to diseased cattle, horses, or sheep, and hence are peculiarly useful, when any of these animals abound with gross humours (9).

5. Sandy downs on the sea shore, are often more valuable, *in their natural state*, than after cultivation. In a state of nature, they frequently afford good pasture for sheep and rabbits, and at other times, produce grasses that may be used as food for cattle, or as litter. But the great object should be, to raise plants which contribute to fix these soils, and to prevent them from being drifted by the winds, which often occasion incalculable mischief (10).

On poor sandy soils, in inland districts, rabbits are the usual stock. Many warrens have been cultivated for raising crops of grain, but rabbits would frequently pay better. It would often be more profitable, therefore, to convert them again into warren, or where wood is valuable, to plant them with fir.

6. Along the banks of lakes and rivers, as well as the sea-shore, there are extensive tracts, in a waste state; and likely to remain neglected, from deficiency of soil. Where the land, however, is composed of alluvial particles, it may be embanked, and afterwards improved by the usual operations of agriculture.

2. *Natural Obstacles to the Cultivation of Wastes.*

The chief natural impediments to the cultivation of wastes are, 1. Woods; 2. Shrubs, or woody plants; 3. Fern; 4. Heath; 5. Coarse herbage; 6. Stones; and 7. Rocks.

1. *Woods.*—The growth of large trees, though a great impediment to cultivation, is a sign that the soil is naturally fertile. It must also have been enriched, by the quantity of leaves, which, in the course of ages, have fallen and rotted upon the surface. Such are the beneficial effects of this process, that after the trees have been cut down, the soil has often been kept under crops of grain for a number of years, without interruption, or any addition of manure. Land thus treated, however, ultimately becomes so much reduced, by great exhaustion, that it will not bear a crop worth the expense of seed and labour ([11]). It is evident however, that this deterioration, entirely proceeds from the improvident management previously adopted.

In reclaiming such wastes, the branches of any trees that are felled, are generally collected and burnt; and the ashes, either in whole or in part, are spread on the ground, by which the fertility of the soil is excited. Indeed, where there is no demand for timber on the spot, nor the means of conveyance to any advantageous market, the whole wood is burnt, and the ashes applied as manure.

In various parts of England, much coppice land has been grubbed up, and brought into tillage ([12]). In Oxfordshire, the temptation is considerable, as from L.30 to L.35 per acre may be obtained, and the land left in a state fit for the plough ([13]). Sometimes woods are grubbed for pasture merely. In that case, the ground should be as little broken as possible, because the surface of the land, owing to the dead wood and leaves rotting, time out of mind upon it, is much better than the mould below. It soon gets into good pasture as grass land without sowing any seed ([14]). But by far the most eligible mode of converting woodland into arable, is merely to cut down the trees, and to leave the land in a state of grass, until the roots have decayed, cutting down with the scythe, from time to time, any young shoots that may arise. The roots, in this way, instead of being a cause of anxiety and expense, as they generally are, become a source of improvement; and a grassy surface is prepared for the operation of sod-burning ([15]). Wherever it is practicable, the land should be well limed, which will greatly increase its value ([16]).

In Scotland, natural woods and plantations have been successfully grubbed up. In the Lower Torwood in Stirlingshire, many acres of natural coppice were cleared, at an expense of from L.15 to L.20 per acre; and the land is now become as valuable as any in the neighbourhood ([17]). On the banks of the Clyde and the Avon, coppices have been cut down; and after being drained, cultivated and manured, the land has been converted into productive orchards.

In Perthshire also, several thousand acres of plantations have been rooted out, the soil subjected to the plough, converted into good arable land, and profitably employed in tillage ([18]).

2. *Shrubs.*—Land covered with furze, broom, and other shrubs, is, generally speaking, well adapted for cultivation. Furze, or whins, (*ulex europæus*), will thrive in a dense clay soil; and where they are found in a thriving state, every species of grain, of roots and grasses, may be cultivated with advantage. The broom, on the other hand, prefers a dry, gravelly, or sandy soil, such as is adapted for the production of turnips. A large proportion of the arable land, in the richest districts of England and Scotland, was originally covered by these two plants; and vast tracts still remain in that state, which might be profitably brought under cultivation. For that purpose, the shrubs ought to be cut down, the ground trenched, or the plants rooted out by a strong plough, drawn by four or six horses, and the roots and shrubs, (if not wanted for other purposes), burnt in heaps, and the ashes spread equally over the surface ([19]). In many places, shrubs and brushwood may be sold for more than the expense of rooting them out. When coal is not abundant, and limestone, or chalk can be had, the furze should be employed in burning the lime that is used in carrying on the

improvement [20]. It requires constant attention, however, to prevent such plants from again getting possession of the ground, when it is restored to pasture. This can best be effected, by ploughing up the land occasionally, taking a few crops of potatoes, turnips or tares in rows, and restoring it to be pastured by sheep. In moist weather also, the tender shoot of every shrub, as it arises, should be pulled up and destroyed [21].

3. *Fern or Brakes* [22].—This is a very troublesome weed to extirpate, as, in many soils, it sends down its roots into the under stratum, beyond the reach of the deepest ploughing; but it is a sign of the goodness of any soil, where it grows to a large size. June or July are the best seasons for destroying it, when the plants are full of sap, and when they ought to be frequently cut. They are not, however, easily subdued, as they often appear after a rotation of seven years, including a fallow, and sometimes require another rotation, and repeated cutting, before their final disappearance can be effected [23]. Lime, in its caustic state, is peculiarly hostile to fern; at the same time, it can hardly be completely eradicated, but by frequent cultivation, and by green crops assisted by the hoe [24].

4. *Heath.*—This hardy plant, when young, is palatable and nutritious to sheep; and under its protection, coarse grasses are often produced. When in flower, it may be cut, and converted into an inferior species of winter provision for stock. But where it can be obtained, it is desirable to have grass in its stead. For that purpose, the land may be flooded, where that process is practicable, or the heath burnt in March or April, and kept free from stock for eighteen months, in consequence of which, many new grasses will spring up, from the destruction of the heath, and the enriching quality of the ashes. The improvement is very great; more especially if the land be drained, and lime or compost be applied [25]. But if the land be too soon pastured, the grasses, being weak and tender, the sheep or cattle will pull them up with their roots, and the pasture is materially injured [26]. Where it is proposed to cultivate the land for arable crops, the lime applied, should be in a finely powdered state, highly caustic, and as equally spread as possible [27].

5. *Coarse Herbage.*—It is often necessary to burn coarse herbage, before the surface can be pared and burnt. Some have recommended, making a compost of the pared surface, with lime, or building *folds*, (earthen walls of the sods),

which, by the action of the atmosphere, become friable and fertile ([28]); but these processes are slower, and not so effectual as paring and burning.

In coarse rough pastures ant-hills frequently abound. A successful experiment has been tried, of mixing these hills with lime; and the compost was found to answer well for barley and grass seeds ([29]). But if possible they should be burnt ([30]).

6. *Stones.*—The stones which impede the improvement of land, are either loose, thrown up when the land is trenched or ploughed; or fixed in the earth, and not to be removed without much labour and expense.

Loose stones may often be converted into use, for the purpose of covered drains,—of constructing walls or fences,—or making and repairing roads either on the farm, or in the neighbourhood; and on these accounts, are sometimes worth the trouble of collecting. They may be removed with the least inconvenience when the land is fallowed. Where loose stones are of a moderate size, they are sometimes found advantageous rather than detrimental, as in the stone-brash soils of Somerset, and other districts. They prevent evaporation, and thus preserve moisture in the soil; and if they are of a porous quality, they absorb moisture when it is redundant, and give it out when deficient. Hence farmers have resolved to bring back again to their corn fields, those very stones they had been induced to carry off ([31]).

Where stones are large, and fixed in the earth, if they appear above the surface, they should be removed before the ploughing of the waste commences: but where they are concealed under the surface, various modes to get rid of them have been adopted. In some parts of Yorkshire, the whole surface is gone over with sharp prongs, which, at the distance of every twelve or fourteen inches, are thrust into the ground, to the depth of about a foot, to ascertain where stones are to be met with. The spot is marked by a twig, and the stones are removed before the land is ploughed. Sometimes the plough is used without such previous examination, and the place marked where stones are encountered, that they may be taken away;—and sometimes, in order to discover and remove such stones, the land is trenched by the spade, the best of all methods of breaking up waste land for the first time ([32]).

Stones above the surface, may be avoided by the ploughman, though not without loss of ground; but stones under the surface, are often not discovered till the plough is drawn against them, and perhaps broken, by which a day's work is sometimes lost ([33]). Clearing the ground from stones, not only prevents such mischiefs, but is attended with actual profit. When removed, they may be used for various purposes, and are often less expensive than if dug, or purchased at a quarry. The soil round a large stone, is likewise, in general, the best in the field, and is cheaply purchased, by the expense of taking out the stone, as the plough has thus access to all the land around it. In stony land, the plough must proceed slowly, and cannot perform half so much work as it ought to do; but, after such impediments have been removed, the field may be cultivated with the usual facility and cheapness, and in a much more perfect manner. It frequently happens, that when working stony land, more expense is incurred in one season, by the breaking of ploughs, besides the injury done to the horses and harness, than would cure the evil ([34]). Had the ground been trenched, this evil would have been prevented.

There are various modes of getting rid of stones. They are generally of such a size as to admit of their being conveyed away in carts, or other vehicles calculated for that purpose. Some ingenious artificers have constructed machines for raising them, when of a large size ([35]). On some occasions, pits have been dug close to large stones, and the latter have been turned into the former, at such a depth, as to lie out of the reach of the plough. But it is frequently necessary, to reduce their size, by the force of gunpowder, before they can be removed. When the stones consist of sand-stone, or even granite, their size may be diminished by the use of wedges.

7. *Rocks.*—When rocks interrupt cultivation, recourse must be had to blasting, unless the stone is in thin layers, or beds, and can easily be penetrated by wedges. They must be quarried out to a sufficient depth, and then covered over with earth, to admit the operations of tillage.

3. *Means of reclaiming Wastes.*

There are six modes by which waste lands, according to their nature and situation, are prepared for the production of crops: 1. Paring and burning; 2. Trenching by the spade and mattock; 3. Deep ploughing; 4. Covering the surface with earth; 5. Floating off the surface of peat-bogs, when there is a valuable soil below; and, 6. Rolling, the utility of which, in promoting the improvement of peaty soils, by consolidating their texture, has not yet been sufficiently attended to.

1. *Paring and burning.*—This operation, and its merits, shall be more fully discussed in a subsequent Section, (No. 5). At present, it is sufficient to remark, that it is greatly to be preferred, to every other method for reclaiming barren land, *where the turf will produce an adequate quantity of ashes* (36). It is proved by experiment, that it is much less expensive than clearing the land by tillage—produces better crops,—and leaves the land in a better state for cultivation (37). But where the ground is deficient in vegetable matter, or if it be full of stones and rocks, or covered with wood, other means must be resorted to. If it be covered with wood, instead of attempting to burn the surface, the trees and underwood must be cut down, and reduced to ashes, by which some good crops are ensured. Previous to the improvement of land covered with furze or broom, some recommend, burning the plants upon the ground, with a view, not only of facilitating their extirpation, but of obtaining the ashes they produce, which, with the ashes from the grass and roots to be found on the surface, will greatly tend to fertilize the soil; but others maintain, that the best system is, to dig up these plants by the roots, spreading them on the surface till they rot, and burning only what has not become rotten, by this process.

2. *Trenching.*—Where the soil is shallow, and the subsoil hard and stony, it is frequently advisable, after extirpating the worthless plants, to manure the surface, and without attempting to remove the stones, to convert the land into permanent pasture; but when there are circumstances which make it advisable, to render this soil arable, the most effectual means of accomplishing that object is, by the spade and the mattock. In that case, if the surface be unfertile, it is laid flat, with the top inverted at the bottom of the trench, where it operates as a hollow-drain. By means of trenching, every stone which can interrupt the future ploughing of the soil, is discovered and removed, either by the usual instruments, or by the application of gunpowder; the ground is deepened to the extent of from thirteen to fourteen inches; and as it contains no weeds, it only wants a sufficient quantity of dung and calcareous earth, to put it in a state fit for vegetation, and to enable it to produce crops of grain. By this plan, more or less perfectly conducted, about 20,000 acres in all, have been added to the cultivated land of one single county, (Aberdeenshire). The process where stones abound,

has been found very expensive, (as high as from L.40 to L.50, and some cases L.100 per acre); but one-half of the expense has often been repaid by the sale of the stones for paving, or building; and, in the vicinity of the city of Aberdeen, the land has afterwards let for L.5 per acre ([38]), by which the expense has been indemnified. Land, however, not attended with peculiar difficulties, may be trenched at from L.8 to L.10 per acre, and even for less ([39]). If delved only about ten or twelve inches deep, the expense will not exceed L.3 per acre.

3. *Deep ploughing.*—This method of improving land, is applicable to poor clays, covered with heath or furze, and rather wet and stony. The under stratum of such clays, being uncommonly obstinate, it requires at least four, and sometimes six strong horses to make a furrow of sufficient depth. Care also should be taken, to lay the sod or turf as flat on its back as possible, for fifteen or eighteen months, in order that it may be thoroughly rotted. When the soil is dry, lime may be spread upon the surface, and allowed to remain in that state for two years, previous to its being again ploughed. By these means, considerable tracts of waste land have been rendered capable of regular cultivation. But this is a tedious and expensive mode of accomplishing the object.

The most extraordinary improvement by ploughing, was made by the late Mr Barclay of Ury. The implements he used were uncommonly strong, and he employed six, and sometimes eight powerful horses in the draught. He made the plough to descend, in spite of every obstruction, sixteen or seventeen inches at once; and after carrying off the stones, which were turned up as if from a quarry, he repeated these operations, till in the end he obtained a free soil, cleared of stones, twelve or fourteen inches deep, and fit for every agricultural purpose. Sometimes a thousand cart-loads of stones were removed from one acre, and the surface of the land was evidently lowered several inches before the improvement was completed ([40]). So great an expense could hardly be indemnified. Where only small patches of stony land are in a field, it may be proper to clear them of stones; but as a general mode of improving extensive moors, it is not to be recommended.

4. *Covering the surface with Earth, &c.*—In England, this mode of improvement has been practised, not only in regard to bogs, but also light sandy soils.

The celebrated Duke of Bridgewater effected a considerable improvement in this manner. He covered a part of Chat-moss, with the refuse of coal-pits, (a mixture of earths and stones of different qualities and sizes,) which were brought in barges out of the interior of a mountain; and, by compressing the surface, enabled it to bear pasturing stock. Its fertility was promoted by the vegetable mould of the morass, which presently rose, and mixed with the heavier materials which were spread upon it ([41]).

The method of covering the surface of fen-land with clay or marl, is strongly recommended in a paper on the Improvement of Huntingdonshire. It appears, that under the fens of that county, and not far from the surface, there is a species of clay marl, of a soft quality, that may be easily worked. Where that substance is mixed with the fen soil, the finer grasses flourish beyond what they do on the fen soil unmixed; and when the mixed soil is ploughed, and sown with any sort of grain, the calcareous earth renders the crops less apt to fall down, the produce is greater, and the grain of better quality than on any other part of the land ([42]). In some parts of Thorney Fen, (on the estate of the Duke of Bedford), the tenants have begun the practice of *claying* the light surface, by trenching with a spade.

Mr Rodwell in Suffolk, has distinguished himself by covering the surface of heath-land with clay and marl, to a very extraordinary extent. With only two leases of 28 years in duration, he clayed and marled 820 acres, and used about 140,000 tumbril loads, which, at 8½d. per yard, cost him L.4958. Having taken a third lease, in the space of about 49 weeks, he employed 11,275 cubical yards of clay more in covering the soil. He prefers clay to marl on sandy soils, some of which consist of coarse, poor, and even black sand. The result was highly satisfactory: L. 350 per annum were added to the value of the estate, which, at 30 years' purchase, is L. 10,500; and the public was benefited by the production of more corn, meat, and wool, to the amount of L. 30,000, in 28 years succeeding the improvement, than in the 28 preceding it ([43]).

In various districts, the soil is covered with chalk, at the rate of from sixty to one hundred loads per acre, and it is considered to be a profitable practice ([44]).

In Scotland, this practice has been restricted to peat-bogs. In several instances, the whole surface has been covered with earth, clay, sand, gravel, shells, or sea-ooze, from one to two inches thick, or more, (for it cannot well be overdone), and land, originally of no value, has thus been rendered worth from L. 2 to L. 3 and even L. 4 per acre. The horses upon such soil, must either be equipped with wooden clogs, or the work performed in frosty weather, when the surface of the moss is hard. Coarse obdurate clay, (provincially *till*), is peculiarly calculated for this process, as it melts with the weather, and by mixing minutely with the fibres of the moss, it keeps out the drought, accelerates the decomposition of the moss earth, and when it is blended with peat, and some calcareous matter, it contains all the properties of a fertile soil (45). This is certainly an expensive method of improving land, unless the substance to be laid upon it, is within 500 yards distance; but where it can properly be done, the moss thus obtains solidity, and after it has been supplied with calcareous earth, it may be cultivated, like other soils, in a rotation of white and green crops. In the neighbourhood of populous towns, where the rent of land is high, the covering substance may be conveyed from a greater distance than 500 yards.

5. *Floating off the Surface of Peat-Bogs.*—This singular mode of improving waste lands, *is applicable only* where there is a command of water, and where the subjacent clay is of a most fertile quality, or consists of alluvial soil. A stream of water is brought into the moss, into which the spongy upper stratum is first thrown, and afterwards the heavier moss; the whole is then conveyed, by the stream, into the neighbouring river, and thence to the sea. The moss thus got rid of, in the most remarkable instance of floating, (that of Blair Drummond in Perthshire), was, on an average, about seven feet deep. Much ingenuity was displayed in constructing the machinery, to supply water for removing the moss, previous to the improvement of the rich soil below. It required both the genius and the perseverance of Lord Kames to complete this scheme; but by this singular mode of improvement, about 1000 English acres have been already cleared, a population of above 900 inhabitants furnished with the means of subsistence, and an extensive district, where only snipes and moor-fowl were formerly maintained, is now converted, *as if by magic*, into a rich and fertile *carse* (46), or tract of alluvial soil, worth from L. 3 to L. 4 per acre (47). But there are very few situations capable of this improvement.

6. *Rolling.*—The improvement of peaty or moory soils, by rolling, in conjunction with the other operations above explained, is of the highest importance. The greatest de-

fect of soft soils is, that the drought easily penetrates them, and they become too open. The roller is an antidote to that evil, and the expense is the only thing that ought to set bounds to the practice of this operation. It also tends to destroy those worms, grubs, and insects, with which light and fenny land is apt to be infested.

The roller for such soils ought not to be heavy, nor of a narrow diameter. If it be weighty, and the diameter small, it sinks too much where the pressure falls, which causes the soft moss to rise before and behind the roller, and thus, instead of consolidating, it rends the soil. A gentle pressure consolidates moss, but too much weight has a contrary effect. A roller for moss, ought therefore to be formed of wood, the cylinder about four feet diameter, and mounted, so as to be drawn by two or three men. If horses are employed, they ought to have clogs or pattens, if likely to sink (48). The oftener the rolling is performed, on spongy soils, (as long as the crops of corn or grass will admit of it), the better, and the more certain is the result (49).

After waste land has thus been reclaimed, it may of course be still further improved, by the usual processes, to be afterwards explained, under the several heads of *inclosing*, *draining*, *manuring* (50), *irrigation*, &c. Where such land, however, lies in a cold and exposed situation, or is so encumbered with rocks and stones, that clearing them would be attended with much expense, and where it would be of little value in pasture, the best mode of improvement is certainly *by planting*. Indeed, both in Scotland and in the Netherlands, it has been found, that planting waste lands, even in low situations, is the surest means of laying a foundation for their future fertility and cultivation; the surface being thus covered and the soil enriched, by the annual accession of vegetable matter, from the decayed leaves (51).

4. *Rules to be observed regarding the Improvement of Waste Lands.*

In the cultivation of wastes, the following rules may be laid down:

1. Not to attempt any scheme of improvement, without the fullest deliberation, nor without the command of an adequate capital, and above all, whatever is done, to do it *effectually*, and not to think of laying on four acres, the manure

necessary for three; nor the lime, chalk, clay or gravel, upon two acres, that should be employed in covering one ([52]).

2. Not to begin on too great a scale, nor until by experience it be found, that the plan to be adopted is suitable to the soil, situation, and climate ([53]).

3. When the intention is to cultivate peat-moss, it ought to be relieved of stagnant water, and converted into well-formed ridges, at least one year before it is cropped. In soft spongy flow-moss, it may be allowed to remain exposed to atmospheric influence, for two years or more, before it is put under crop.

4. The ridges or mossy-soils, ought to be from sixteen to even twenty feet in width, and raised in proportion. When the bottom is of a retentive nature, the soil above it is apt to retain a great superfluity of moisture, and to become wet and spongy, and thus the dung, lime, or other manure is prevented from operating successfully in the production of useful plants. As a proof of the importance of this suggestion, it may be observed, that very good crops of corn and roots, have been raised in new land, on *elevated* lazy beds, when they could not be procured on flat ridges.

5. All mossy soils should be ploughed or dug in autumn, that they may be exposed to rain and frost, and thus converted into soil. If moss is for the first time put into cultivation in spring or summer, it dries *into peat*, which is a hard substance, and not easily decomposed.

6. If dung can be obtained from any neighbouring town or village, it should be secured, that the land already cultivated may not be robbed of its manure; but if part of that valuable substance should be required, to commence improvement on the moss, it would soon be repaid by the straw raised from the moss, and when the moss is reclaimed with lime, &c. it will soon yield dung to the farm land.

7. The last rule is, to lay down land, improved from waste, more especially in high and bleak situations, as soon as possible into grass, and to retain it in that state, as long as it is tolerably productive. In all lands naturally barren, or in soils even of a medium quality, the rich grasses perish, and inferior sorts spring up, if the land be not top-dressed with lime, manured with dung, and cropped every seven or ten years; but if occasionally manured and cropped for one or two years, the moss plants are extirpated, and the pasture is completely renovated.

It may be proper to add, that the improvement of waste lands entirely depends on the amount of capital, judiciously expended in the attainment of that object. If a person attempts to improve waste land, at the expense of L.5 per acre, he will probably lose his money, and the soil will soon revert to its former state of barrenness. If he lays out on the improvement, L.10 per acre, he may perhaps be indemnified *for his expenditure.* But if he resolves, thoroughly to improve the soil, and for that purpose, will judiciously expend, from L.15 to L.20 per acre, uniting enriching to calcareous manures, *he will make a fortune;* for the first two crops, will in a great measure defray the expense of the improvement, and the soil will be as capable of producing good returns in succession, as land that had been longer cultivated.

5. *Of the Advantages to be derived from the Culture of Waste Lands.*

These are either of a private or of a public nature.

1. *Private advantages.*—It has been thought, that greater profit may be derived from the improvement of wastes, or of lands not hitherto completely cultivated, than of similar soils that have been lóng under the plough. The rent is necessarily lower, they are freer from weeds, and if once brought into good order, and properly managed afterwards, will give lucrative returns. Instances might be stated in support of the above doctrine, but unfortunately it has not in every case been sanctioned by experience. The real cause is, that a great expense must be incurred in the first instance, while the subsequent advantages are uncertain.

As it is impossible to go through the numerous examples of the profitable improvement of wastes, in such a condensed work as the present, it is proposed to state three of the most important instances that England and Scotland can respectively furnish.

A variety of experiments in the culture of wastes, have been made on the estates of a distinguished friend to agriculture, Charles Duncombe, Esq. (now Lord Feversham), the principal particulars of which, are detailed in his Communications to the Board of Agriculture ([54]). The whole contains about 840 acres; and what renders these experiments peculiarly important, is, that a considerable proportion of the land was improved in small lots, by several persons, and under different systems. The following results have been drawn from these experiments: 1. That by paring and burning, the matted substance of peat, and the roots of heath were reduced to a substance that assists vegetation, and the land being thus sooner brought into cultivation than by any other process, that plan ought to be preferred [55]. 2. That in an elevated situation, and a bleak climate, rye ought to be the first crop [56]. 3. That potatoes is the most productive crop, provided long dung could be spared. 4. That lime materially assists in decomposing vegetable substances, and ameliorating the soil; and, 5. That when such lands are laid down with artificial grass-seeds, it is most advisable to pasture the grass, and not to convert it into hay.

The exertions made for the improvement of Chat-moss, in the county of Lancaster, do credit to the zeal and ability of the late Mr Roscoe, so well known as a distinguished literary character. This tract contains about 2500 acres, entirely composed of peat, from ten to thirty feet deep. The drainage was begun in November 1805, but it was not till the year 1809, that any crops were raised, and these were restricted to about 20 acres of oats and turnips. In the succeeding year, 80 acres were cropped, of which 20 were wheat; and it soon appeared that, under a judicious system, abundant crops of wheat, beans, oats, potatoes, and clover might be expected [57].

Mr Roscoe has given a statement of the expense of improving and cropping an acre of Chat-moss, in 1812, with its produce. The expenses, including 20 tons of Manchester manure, for which, and its conveyance, L.5 are charged, amount in all to L.20, 7s. per acre. He states, that the crops, with the value of the straw, repaid the full expense the first year, the price of grain being high; but even at more moderate rates, there can be no doubt, that the money expended in the improvement may be speedily returned.

Mr Roscoe considers calcareous manure as essential to the improvement of peat-moss. As the quantity of lime necessary for that purpose is so small, in proportion to that of marl, where the distance is great, and the carriage high, it is more advisable to make use of the former substance; but where marl is upon the spot, and can be obtained in sufficient quantities, at a reasonable expense, the use of it appears to be preferable.

The result of Mr Roscoe's experiments is, that all temporizing expedients are fallacious; and that there is no effectual method of improving peat-bogs, or moss land, *but by the application of calcareous substances, in sufficient quantities to convert the moss into a soil, and by the occasional use of animal or other extraneous manures, such as the course of cultivation, and the nature of the crops, may be found to require* [58].

In Scotland, Mr Maclean of Mark, in Galloway, is one of the most distinguished characters in that line ([59]), having improved no less a quantity than 687 English acres of waste land. He conducts this business with such ability, joined to economy, that he never reclaimed an acre, which has not made him a large return for the capital expended. The land he has improved, is upwards of 400 feet above the level of the sea, and the soils are greatly diversified. His example is a great encouragement to all proprietors of waste lands, to set about improving them without delay, as, in that way, their interest would be better promoted, than by any other plan that could be suggested. It is sometimes by paring and burning, and at other times by covering the surface, according to the nature of the soil, and other circumstances, that his improvements were carried on ([60]).

Among the various modes of improving wastes, that of bringing them into a state of cultivation, by establishing colonies of labourers, fishermen, tradesmen, &c. in advantageous situations, has been found beneficial to the proprietor and to the public:—to the first, because his land is improved, perhaps without any expense being incurred by him; and to the second, because, as a distinguished character has well observed, when land is given to a cottager for a number of years, under a small reserved rent, he and his family will exert in its cultivation, a quantity of labour *which would not otherwise be called into action;* and by which, many thousand acres of land may be cultivated, which would not, in any other mode, pay the expense of improvement ([61]).

Public advantages.—Whether exertions for the improvement of wastes, are beneficial or injurious to the undertaker, there can be no doubt, that they are advantageous to the public. By these means, thousands of acres have been already added to the national stock, of arable land, which, in proportion to their extent, will continue to yield food for our increased population. Besides the multitudes employed in reclaiming these wastes, occupation is provided for as many persons as are requisite for their subsequent cultivation; and the surplus food, beyond what the actual cultivators may require, increases the fund of provisions for maintaining those who are employed in manufactures and commerce. In all these respects, the improvement of waste and unproductive land, is an object of very high national importance, and well deserves the attention, and indeed the encouragement of the Legislature ([62]).

†

The following tables will give some idea, of the importance of this great national resource, 1. In Ireland; and, 2. In Great Britain.

1. *Ireland.*—The whole extent of Ireland, is calculated by Mr Nimmo, at 12 millions of Irish acres, which he divides as follows:

	No. of Irish acres.
1. Tillage land,	8,500,000
2. Bog,	2,000,000
3. Uncultivated mountain,	1,500,000
Total,	12,000,000

2. *Great Britain.*—In this island, as appears from the following estimate, the proportion of waste land is still more considerable.

		No. of acres.
1. Extent of land brought into a state of *perfect cultivation*,		5,000,000
2. Lands cultivated, but capable of *additional improvement*,		46,000,000
		51,000,000
Waste lands fit for tillage,	3,000,000	
Ditto, capable of being converted into water meadows,	1,000,000	
Ditto, into upland pasture,	13,000,000	
Ditto, into plantations,	3,000,000	
Ditto, unfit for planting or any other improvement,	2,000,000	
		22,000,000
Total acres,		73,000,000

I cannot conclude this important subject, without remarking, that the improvement of our wastes, must be greatly facilitated, by the use of bone-dust. It is now ascertained, that a small quantity of that manure, which can be conveyed at a trifling expense to any distance, will raise large crops of drilled turnips, by the skilful consumption of which, great quantities of manure may be obtained. Our waste lands may thus be easily supplied with that great source of fertility; and already, (by means of that manure), extensive tracts of *Wolds*, or High-lands, in Yorkshire, Nottinghamshire and other districts, have been improved. (See Addenda, No. XIV.)

Another recent discovery, namely, that the application of sulphuric acid converts lime into gypsum, may also prove of essential importance. This circumstance cannot fail to produce great additional improvements in our waste lands, as that description of manure, is so peculiarly favourable to the growth of clover.

Sect. II.—*On the Nature and Advantages of Inclosures.*

The benefit to be derived from dividing lands under cultivation, into regular fields, has been already explained. (See Chapter II. Sect. 10). It is here proposed to consider,—The advantages and disadvantages of having these fields *inclosed* and *fenced*;—The sorts of inclosures best calculated for different soils and situations;—The principal fences to be recommended;—The effect of hedge-rows; and,—Some miscellaneous particulars connected with the subject of inclosure.

1. *Advantages and Disadvantages of Inclosures.*

Inclosures and fences, when judiciously designed, and properly executed, are attended with the following advantages:

1. The mere inclosure of wastes, lays the foundation of their future fertility. By the shelter thus obtained, and by the plants being protected from poaching, the natural grasses are enabled to make more progress, than if the field had been left open and exposed; and by the dung of the sheep or cattle pastured thereon, the ground is gradually enriched, and ultimately rendered fit for cropping, when cultivation is afterwards resorted to ([63]).

2. Where lands are wet, the ditches employed in fencing them, both render the inclosure dry, and may supply it with running water, in situations where that article is required.

3. In cold climates, and more especially in bleak situations, the effects of inclosure, in sheltering the land, and rendering it more productive, are hardly credible to those who have not experienced them ([64]). In a mountainous district where that plan was adopted, the climate was rendered milder, the soil more productive, the tenantry became more comfortable in their circumstances, and some so affluent, that they could purchase the fee-simple of their farms ([65]).

4. In pasturage, the advantages of inclosures are of the highest importance. The farmer is, in a great degree relieved, from the heavy expense of attending his stock; and the risk of their being injured or stolen, is likewise greatly diminished. He has it also in his power to arrange them, according to their age, condition, and other circumstances. The pasturing stock are not only protected from being

perpetually harassed and interrupted in their feeding by dogs, or other intruders, but in general, have access to water when they please, and by these means, improve much faster, than on the same extent of uninclosed land. The grass, where protected by the fences, owing to greater shelter thus obtained, is earlier and more abundant, than in bleak exposed open lands of similar soils, and in the same neighbourhood. The live stock, in the summer season, suffer less from heat, are protected in cold and stormy weather ([66]), and in particular, have sheltered places to resort to, where they may sleep or ruminate. The stock likewise being more quiet, do not poach the ground so much in wet weather ([67]). From these advantages, joined to that important one, of being enabled to shift from one field to another, for fresh supplies of grass, experienced graziers entertain the highest opinion of their utility ([68]).

5. In the management of arable land, many solid advantages are derived from inclosures. When the land is open, it is exposed to trespass; but when inclosed, the farmer is secured against encroachment,—can adopt a correct and profitable rotation of crops,—can proceed with vigour in its cultivation,—and can reap its fruits with safety. An increased produce is the necessary consequence of these advantages. Where corn, however, is the principal object, the inclosures ought to be large.

6. In some districts in England, coals are dear, or fuel scarce, and mixed hedges, from the quantity of wood they produce, are considered to be profitable. The fence, however, in that case, is rarely so good, and more ground than usual must be allotted for the purpose.

7. The oak-timber that grows in hedge-rows, is more valuable than any other for naval purposes, furnishing that *knee-timber*, so essential in the construction of ships of war.

8. The very appearance of inclosures indicates comfort and security. Landlords, on that account, never fail to draw very advanced rents from well-inclosed lands. They are generally let at from 2s. to perhaps 10s. or 15s. per acre higher, than open lands of the same description, in their immediate neighbourhood. Besides this additional rent, the farmer, from a consciousness of the benefit derived from them, will often undertake to uphold the fences, at his own charge, during the lease.

9. Inclosures also, by means of ditches, contribute both to drain, and to improve the climate of a country; while

the neighbourhood of open fields and commons tends to render the rigours of the climate more severe.

In regard to "*The disadvantages of inclosures,*" they need not be dwelt on, as they can only be said to exist in the abuse or mismanagement of the system. Inclosures, when too small, especially on low fertile ground, harbour insects, and produce too much shade. These contribute to deteriorate the quality of the produce; and cattle and sheep are more exposed to torment and danger from different species of flies.

Another species of disadvantage arises from the *injudicious shape* of inclosures, and their not being laid out according to their slope or aspect. These errors have been so glaring and inconvenient, that in some instances, old inclosures have been entirely new divided, and the old fences grubbed up.

It has also been remarked, that inclosures are attended with this disadvantage, that they retain moisture among the trees and hedges, and prevent the full effect of wind in drying the crop during harvest. But this inconvenience is in some degree compensated by the corn becoming earlier ripe, from the warmth which the inclosures furnish.

Some have imagined, that the soil might be injured, by the greater evaporation which the warmth of inclosures may occasion. But it can hardly be disputed, that evaporation is more effectually promoted, by free air and wind, than by heat.

On the whole, it appears, that the arguments in favour of inclosures, as a general system, greatly preponderate: nor is it an unimportant consideration, that they give a country a more ornamental and picturesque appearance.

2. *The Sorts of Inclosures adapted for different Soils and Situations.*

The nature and size of inclosures, ought to vary according to situation and other circumstances, the principles of which shall be briefly explained.

1. *Inclosures in the vicinity of towns.*—Near a town, small inclosures are usually preferred. From five to ten acres may, in general, be considered as the most convenient size. As wooden fences and dead hedges are liable to depredations, the most advisable fences for such inclosures are, either quick hedges dressed thick and low, or stone walls, edged, or tipt with lime (57).

2. *Inclosures in low and rich soils.*—Where the soil is re-

tentive of moisture, open drains or ditches are used, for the double purpose of dividing the fields, and clearing them from superfluous water; but unless the stock are accustomed to such a fence, they are apt to fall into the ditches, by which some are maimed, and occasionally destroyed; and if posts and rails are erected to prevent such accidents, they seldom last long (72). If smaller drains are wanted, they ought to be covered, that all the valuable soil that can possibly be obtained, may be turned to profitable use. Where it would be an imprudent waste, to occupy valuable land in fences, stone walls are to be preferred; or a fence of white-thorn may be raised; but that species of fence requires to be protected till the thorns grow up. The best protection for such a fence, is either a railing of wood, or a hedge of dead thorn, cut to about 27 inches in length, and fixed in the top of the dike; or if stones are at hand, they may be raised to the height of 15 or 18 inches on the top of the dike. By any of these modes, the fence will be rendered complete at once, and kept so, till the growing thorns become sufficient of themselves.

3. *Inclosures in low arable Farms.*—In such situations, where circumstances permit, the fields should be from fifteen to twenty-five or thirty acres; and the fences either stone walls, or hedges trained close and low. Some smaller inclosures near the dwelling-house, are of use, according to the size of the farm, for various purposes, in particular, for the rearing of calves or young horses, where they may be attended to, and watched with greater convenience.

4. *Inclosures in upland Farms.*—The soil of upland farms is generally cold, and of inferior quality. To secure early and rich grass, and to shelter the live stock, the inclosures ought to be considerably smaller than in lower farms; belts of several sorts of wood should be raised, or hedges of beech or holly, which, though of slow growth, will certainly thrive in dry and gravelly soils where the thorn would fail. In Devonshire and Cornwall, it is usual to make copse fences on large mounds of earth, which, in time, pay for the expense of making them, by the fuel they afford, and the shelter they furnish, both to the land and the cattle.

5. *Inclosures on mountain Sheep-Farms.*—No sheep-farmer can carry on his business with satisfaction and profit, without some inclosures. There ought to be at least *a tup-park*, or inclosure for the rams; *an hospital-park*, for such diseased or unfortunate sheep, as require better food, or more shelter than the rest of the flock; an inclosure for water-

meadow, or early grass; and some inclosed ground for cultivation. Without such aids, the sheep-farmer can never expect to escape the baneful effects of fatal distempers;—nor can he improve the breed and character of his flock;—nor maintain his sheep during severe weather, when they are unable to dig through the frozen snow for subsistence;—nor protect them from general destruction, during snow-drifts, if the farm be entirely open. For these obvious reasons, every sheep-farm ought, if possible, to be accommodated with several inclosures, well fenced with strong walls, and constructed in the most effectual and approved manner.

6. *Inclosures on New Farms.*—The plan of inclosure to be adopted on new farms, depends upon circumstances. If a considerable extent of arable land must be separated from mountain pasture, a ring-fence, consisting of a strong wall, with a rough stone coping, placed edgewise, (the Galloway dike), ought to be constructed for that purpose, within which is to be comprehended, the arable land, the meadow, and the cow-pasture; and contiguous to this general fence, plantations ought to be made for shelter and ornament. If the whole farm, though bleakly situated, be capable of cultivation, belts of planting ought to be formed on the more exposed parts, and hedges raised as subdivisions. Besides the hedge-rows, or belts of planting, the corners of the fields, which are not accessible to the plough, may likewise be planted. It is proper to give a bend to the clump, that the plough may be turned more easily: and, adjoining to this clump of wood, a single pond, properly placed, may accommodate several fields (73).

3. *The Nature of the Fences.*

There is a great variety of fences, calculated for different purposes; but the most generally used, are, 1. Stone walls; and, 2. Hedges of thorn, and other plants (74).

1. *Stone Walls.*—This species of fence has one advantage, that, according to a common saying, "*it is major from its birth*," or, in other words, attains its greatest perfection as soon as made. Stone walls, however, have this disadvantage, that they are gradually getting worse; and, according as they are well or ill executed, unless built with lime, require, at the rate of from one to two per cent. per annum, to keep them in repair (75). The propriety of erecting a fence of this kind, depends much upon the nature and quality of the soil to be inclosed;—the quantity and fitness

of the loose stones to be met with in the soil;—the vicinity of the quarry where the stones are dug;—and the advantage of obtaining lime at a moderate expense, by which the construction of the wall can be much improved, and rendered more durable. Where all these favourable circumstances are combined, stone walls, though not so ornamental as hedges, are preferable in point of utility; the benefit of the inclosure being immediate. They also occasion the least waste of ground;—do no injury to corn crops;—do not harbour vermin, if well built or edged with lime;—and are free from the weeds and rubbish which almost invariably accompany live hedges (76).

The expense of erecting stone walls is considerable. Where they are built with lime, and five feet three inches in height, the expense of inclosing a field of moderate size, cannot be estimated at less than ten pounds per acre, even in cases where the lines of division are neither crooked nor irregular (77).

Where lime is not used, "*the Galloway dike*" is preferred to every other species of dry stone wall. It is built *double;* that is to say, the two sides are formed of two different sets of stone, resting against each other, and connected by larger stones, which, from time to time, are laid across the wall. The whole, according to the more recent improvements, is completed, by putting upon the top of the dike, as close as they can be laid together, stones placed edgewise; and when a considerable extent has been thus laid, thin stones are driven in like wedges, at small intervals, which bind the whole so firmly together, that, when well built, a stone can hardly be taken out of the top, without an iron crow (78). Long experience has fully proved, that animals are more deterred from attempting to get over this rugged coping, than a more solid wall, even of a great height, without that peculiarity in its construction.

Through the whole range of the Cotswold hills of Gloucestershire, (from Bath to Stow on the Wold), stone walls, about five feet high, are employed as fences; and the practice is fast extending into the adjacent vales, owing to the uncontrollable disposition of the poor to destroy every combustible article.

The stone is of the white sort, and commonly lies near the surface, in flat beds or strata. This stone perishes by the action of frost, on any *wet* being *confined* in it. The use of lime or other mortar, is *therefore necessarily rejected;* and the prudence or propriety of erecting this fence, in *no sort* depends on vicinity to lime. If the flat bedded stone be carefully selected, and well put together, by masons accustomed to that work, the walls last an indefinite time, and are repaired at a very easy expense. The original cost of a five foot wall of this kind, where, (as is generally the case), the stone lies near at hand, is not more than from 4*s.* 6*d.* to 6*s.* the perch, (statute measure).

It is not possible to say, what is the cost per acre, of inclosing land in this manner, without *defining the extent* and *shape* of the space inclosed. Suppose, (for instance), a field of ten acres, inclosed in a square, the cost would be about L.4 per acre. If in an extended parallelogram of 80 by 20, the expense per acre would be raised to L.5; and for that sum, where the stone is within a moderate distance, any field may be inclosed, the shape of which does not *greatly* deviate from the *square* ([79]).

2. *Hedges of Thorn.*—The hawthorn, (*cratægus oxyacantha*, Linn.) or white thorn, is justly accounted preferable for a fence, to every other plant, hitherto known in Europe ([80]). If placed in a proper soil, it is a quick grower, is of a hardy nature, produces numerous branches, has prickles for its defence, becomes stronger by age, and when properly trained, and occasionally cut over, there is no period to its duration. If suffered to grow too tall, it makes but a bad fence, becoming open below, and from its height, injurious to the crops in its neighbourhood. When hedges, therefore, come to a proper height and strength as fences, they ought to be cut into a shape, the least likely to give obstruction to the motion of the air, or to do injury, either to the roads, or the fields in their neighbourhood ([81]).

If hedge plants of five years old can be procured, Lord Kames maintains, that they deserve all the additional sum that can be demanded for them, as they require less railing for their protection ([82]). Hence the establishment of nurseries, for raising hedge-plants to a stature fit, or nearly fit, to form a fence, with less necessity for their being guarded, has been strongly recommended. Such plants would be of particular use in filling up gaps and unnecessary gateways ([83]).

In Holland, it is not unusual to have *ready formed hedges.* They are trained hedge-ways in the nursery, and being frequently removed from one spot to another, they may, without almost any hazard of failure, be transferred to a considerable distance, and replanted ([84]). It were much to be wished, that so advantageous a plan, which would save the heavy expense of posts and rails, were adopted in this country.

Instead of posts and rails, which are apt to be destroyed, some have tried low walls of stones, to protect the young hedge [85]; and others a mode of planting the hedge, protected by a mound between two ditches, the whole occupying the space of about fourteen feet. By the time the hedge becomes a fence, the ditches are completely filled up by the earth of the mound, so that no ground is lost [86].

If a farm is inclosed by hedges, and cultivated under the alternate husbandry of tillage and pasturage, it is an excellent rule, when the fields are broken up, to cut down the hedges; and thus every objection to the injury sustained from such inclosures, to crops of grain, is obviated. The mode of cutting them down must vary according to circumstances: if the hedge is thin, let it be cut down about six inches from the ground; but if sufficiently thick, from three to four feet. In the former case, all gaps ought to be carefully filled up, which may be effected, not only by inserting new plants, but by laying down branches of the old ones in the gap, as those may be made to take root [87].

The following rules are recommended to the planters of thorn hedges:

1. With a view to utility, it is better to make the whole hedge of one sort of plants, than to have a motley mixture of various shrubs,—unfit for being used as a fence,—producing weak and sickly plants,—injuring each other's growth,—shedding their leaves at different seasons of the year,—and presenting a discordant and offensive appearance [88].

2. Thorns should be planted *in the natural soil*, if it is of a good quality. Their roots thus receive abundant nourishment, and spread, unchecked, with as much freedom as if they grew in a natural state [89]. But when the line of a fence passes through soils of different qualities, it is proper, either to select such species of plants as are suitable for the respective soils, or by drainage, cultivation, and manuring, to equalize them as much as possible, all along the line of the intended fence [90]. In poor soils, it is advisable, to dip their roots in common oil, before they are put into the ground, or to sprinkle a little rotten dung at their roots.

3. The young thorns should be planted with as much expedition as possible after they are taken from the nursery;—they should not be placed deeper in the ground than they had previously stood in the seed-bed;—they should be

laid upon a gentle slope, or inclined plane, pointing downwards, so as to favour the transmission of moisture to the roots;—and they should not be cut, until they have been planted in the ground; when it can be done with more regularity;—the age of the plants, (whether of one or two years), is not so material, as that they should be healthy and well grown ([91]).

4. The cutting of hedge plants is an important operation. They should always be *cut upwards*, and at irregular heights, the strongest cut lowest. The best shape for them to be formed into, is the *hog mane* of a horse, that is, narrow at the top, and wide at the bottom. Every twig thus receives its full share of rain, sun, and air, and the lower branches are not injured or destroyed, by the dropping of water from those above ([92]).

5. Besides preparing the ground for the young plants, by a crop of potatoes or turnips, or by a fallow, and enriching it, (if the soil is poor), by dung or compost, it is necessary, to have the hedge regularly cleaned once, and when young, twice in a season, that the young plants may be kept perfectly free from weeds ([93]).

6. But the most important rule is, to plant the quicks, at from nine to twelve inches apart, according to the fertility of the soils in which they are placed ([94]), and some recommend even a great distance; but at twelve inches, they make more wood, and sooner become a strong and lasting fence. The closer they are planted, the more difficult they must find it to procure nourishment, and the greater number must die. It is well known, that when a quick-hedge comes to be from twenty to thirty years old, few of the thorns are nearer each other than from twelve to eighteen inches ([95]).

As hedges rarely thrive, after the roots of the thorns reach the close impervious bottom on which clays are incumbent, it has been found a useful practice, to cast a deep drain where the hedge is to be planted, and to fill it with stones, covered with good earth. The thorns will thrive as well by this method, as upon soils of a different description ([96]).

Thorns may be raised from the roots cut off, when the plants are to be set in a hedge, as well as from seed. They must be put into a bed of fresh earth, and thus a perpetual succession of vigorous plants may be obtained ([97]).

In making hedges, the plants should be assorted, and all those of the same size put together. Where they cannot be had of uniform strength, the most healthy should be put in the poorest soils, and the weakly in the rich ones ([98]).

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In many cases, from circumstances connected with the situation or soil, other shrubs are used for hedges than the white thorn; though none, on the whole, is comparable to it on suitable soils, or, when properly trained, forms so strong and durable a fence.

The common furze, gorse, or whin, *(ulex europæus)*, will grow on poor soils in exposed situations ([99]). Many hedges of this plant are to met with in Sussex, six or eight feet high, compact and efficient; but they are attended with this disadvantage, that by the bursting of the pods, the seeds are scattered to some distance, and in clearing out the ditches they are carried over all the fields, and are extirpated with great difficulty. The beech, *(fagus sylvatica)*, therefore, is to be preferred, where it will thrive, more especially from the shelter which it affords, as the old leaves remain till the new ones sprout out; thus giving warmth to the adjoining fields, and to the stock pasturing on them, even in the midst of winter. The larch also has been tried with some success; though, it is obvious, that a fence of this sort cannot always answer.

The holly *(ilex aquifolium)* is of slow growth, but forms a close and beautiful evergreen fence. The plants may be removed from the seed-bed the first year, either in May or June, which would be favourable to their thriving; but the plan of raising them from layers of old bushes is to be preferred. Such plants grow much quicker than seedlings, and make good fences in less than half the time.

The horn-beam *(carpinus bitulus)* has been strongly recommended, and seems to merit more attention than has hitherto been paid to it in this country. It is not delicate in point of soil,—will thrive on ground seemingly barren,—and will grow well near the sea. It is likewise a quick grower, and becomes a fence peculiarly solid and permanent ([100]). Its wood also is preferable to yew, or crab, for mill cogs, &c. It may be transplanted of a good size; and should be placed in such a manner, that the two plants may intersect each other, in the form of a St Andrew's cross; which soon becomes a sort of living palisado, or *chevaux de frise*. It is not uncommon in Germany, to see the sides of the high-roads thus guarded for ten miles together ([101]).

In the hedges of England, a great variety of trees are planted, as the hazel, the oak, the ash, the maple, the crab, the willow, &c. These furnish materials for manufacturing various articles,—supply the hop-planter with poles,—or may be used as fuel. Sometimes plums, gooseberries, and other plants, yielding useful and agreeable fruits, are to be met with [102]; but this is a dangerous experiment, alluring idle boys to do much mischief to the hedges; and sometimes the sweet-briar, and all the varieties of the wild rose, are planted, for their smell or beauty. But none of these are so fit to form a fence, as the hawthorn, and the mixture prevents its thriving. The sweet-briar, in particular, invariably injures, and frequently kills the thorns.

4. *Hedge Rows.*

The planting of trees in the line of a hedge is, generally speaking, not to be approved of. Thorns do not thrive so well near the roots, nor under the drop of a tree. The roots also running into the field in all directions, often break and damage the plough, and interrupt the field operations. The corn growing under the shade and drop of trees, is almost universally laid down, of course not filled, unequally ripened, and not so soon ready for the stack-yard as in the other parts of the field. In late and wet seasons, indeed, the corn is seldom harvested in proper condition, and in some instances it is totally lost. The ash, in particular, is a formidable enemy to corn. The influence of its roots, in attracting moisture, and the sources of fertility, may be seen in the circular patch of inferior vegetation in its immediate neighbourhood. In fact, trees in hedges are said to be *the landlord's thieves*, as they steal from the tenant's crop every year, ten times the value of their own increased value. The grass under their shade or drop, is likewise of inferior quality, compared to the other parts of the field, and is unwholesome to stock [103]. In flat countries, therefore, it is better to plant the corners of such fields as are not accessible to the plough, and in them, a great deal of useful timber may be raised. In hilly countries, on the other hand, belts of planting are advisable, not only as being ornamental, but on account of the shelter which they afford to cattle, and other stock.

There are some trees, however, which, comparatively speaking, do much less injury than others. The narrow leaved elm, and the black poplar, are of that description, and above all, the oak, which in hedge rows produces timber, peculiarly well calculated for naval purposes. The planting of the oak therefore, under a judicious system, ought not to be discouraged, for the growth and prosperity of such timber, is of great *national*, as well as private importance [104].

Fruit trees in hedge-rows promise a profit, which is never realised; the fruit being generally stolen, and the trees mutilated ([104]).

5. *Miscellaneous Particulars.*

These principally relate to, Gates, Stiles, and Wickets.

1. *Gates.*—This is a subject of considerable importance, and includes the following particulars: The general properties of such gates;—Their proper position;—The substances on which they ought to be placed;—Their dimensions;—Their form;—and, The materials used in making them.

1. The properties desirable in field gates, are, 1. Strength to resist large cattle; 2. Closeness to confine small; 3. Stability in their form; and, 4. Economy in their construction.

2. Their position must be determined by considering the roads and other communications with which they are connected, the size and form of inclosures to which they lead, and the purposes to which these are intended to be applied.

3. Gates are fixed in various ways. Sometimes on posts of oak or larch, being more durable than foreign fir. Sometimes living trees of considerable size are transplanted with their roots, for gate posts, a practice not to be recommended. Sometimes blocks made from a single stone, of a good quality, and a sufficient size, may be had, and are greatly preferable to timber ([105]); and sometimes round or square pillars are built of stone and lime, with large stones inserted at that part of the pillar on which the gate hangs.

4. No field-gate intended for carriages, ought to be less than nine feet wide; and if the resort is frequent, ten feet is preferable. The height should be about five feet, or nearly the same as that of which fences are usually made.

5. With respect to their construction, there is room for selection out of the various forms now in use. For interior inclosures, a cheap and simple plan is adopted, that of having a pillar at each side, into which four or more moveable bars may be made to slip in or out at pleasure. That plan however, does not answer for passages, if much resorted to. The swing-gate, which turns on hinges at one side, and fastens by a latch at the other, and which may occasionally be shut by a padlock and chain, is the most common in fences. For all places of considerable resort, this gate should be hung, so as to open easily to the traveller, even on horseback, and to shut of itself. The folding gate, consisting of two parts,

is best adapted to wide spaces, where one gate, occupying the whole, would be too large and heavy.

The importance of having gates that shut and open readily, is known to every skilful farmer. When a gate is left open, flocks prone to ramble, are sure to find it. They will probably do much damage to the adjoining fields of turnips, corn or grass; they will become unsettled and dissatisfied with their pasture for many days, and even weeks; and thus the farmer is not only injured in his crop, but in his stock ([107]).

6. The best materials for field-gates are, split oak ([108]), sweet or Spanish chesnut, the locust acacia, and sound red Riga, Memel, or larch fir; materials not very heavy, and which will endure for some time. In some parts of Scotland, and at Birmingham, gates of cast iron are manufactured. They can be made as light as those of wood, and where iron is cheap, about as low in price ([109]). In Cheshire, gates are sometimes made of bar iron, of the ordinary size, at an expense of from two to three pounds ([110]). Great care ought to be taken, to guard gates and pillars by large stones, and to make the roads in their immediate vicinity smooth and hard.

But notwithstanding every precaution, gates are a perpetual source of expense and vexation to the farmer. It has therefore been suggested, as a useful plan, to contract with a carpenter, to keep them in repair at a certain sum per annum. This would induce him, to examine every gate frequently, and thus to preserve them in good order ([111]). For their better security, it has been suggested, that a law shall be passed to punish offenders, who wantonly injure so material a means of protection to agricultural property ([112]). At present, in some places, the stealing of gate hooks and iron fastenings is so common, as to compel the farmer both to hang and to fasten his gates with wood; which is cheaper than iron, though not so secure, nor so lasting ([113]).

2. *Stiles and Wickets.*—These are necessary in inclosures, for the admission of foot passengers, while horses and cattle are thus excluded. They should be simple in their form, and made of durable materials.

On the whole, a well-inclosed farm is a strong inducement to any occupier, to exert his utmost energies in carrying on every species of improvement that can be advantageously undertaken; while, by inclosures, the appearance of the country is improved, its climate ameliorated, and its value materially augmented.

Sect. III.—*On Draining.*

Relieving land from superfluous moisture, is one of the most important branches of husbandry. Unless that be accomplished, every other improvement of which the soil is susceptible, must often be unsuccessfully attempted. Fortunately, no department in agriculture has been of late more anxiously studied, nor with greater practical success. The basis was laid by the discoveries of a farmer in Warwickshire, (Joseph Elkington), who was led to it by an accident (113). It is a happy event for society, when such accidents occur to those, who have sagacity sufficient to avail themselves of hints thus fortuitously suggested.

In discussing this subject, the following particulars shall be considered: 1. The advantages of draining; 2. The causes of wetness; 3. The sorts of drains commonly used; 4. The instruments employed; and, 5. The modes of draining the different soils, and the objects to which that improvement is applicable.

1. *Advantages of Draining.*

The benefit of draining is experienced, 1. In arable land; 2. In grass land; 3. In woods and plantations; 4. In the improvement of wastes; 5. In the climate; and, 6. In various miscellaneous particulars.

1. *Arable Land.*—While land remains in a wet state, the manure laid upon it, whether putrescent or calcareous (114), is, comparatively speaking, of little use;—the seed sown often perishes (115);—the crops are sickly, and later of ripening;—and the operations of harvest are attended with perhaps injury to the soil, uncertainty, and danger. On the other hand, when it is thoroughly drained, land can be ploughed at any season with advantage,—it is easily managed, and can be kept clean at a moderate expense,—every exertion of good husbandry is attended with success,—the ground suffers less from the inclemency of the seasons,—the produce is generally ample,—the quality of the grain is excellent,—and the farmer will thrive, where his predecessor, cultivating a wet and undrained soil, was impoverished, or perhaps totally ruined.

2. *Grass Land.*—The beneficial effects of draining on grass land are also very great. It is less liable to be poached;—rushes and other aquatic plants soon disappear;—the finer grasses rise in abundance;—the pastures maintain a greater number of cattle and sheep;—the stock becomes superior in size and quality, and less subject to disease ([116]);—that destructive malady, *the rot*, so fatal to sheep, is prevented;—and if the land be mown, the hay produced is much improved in quality.

3. *Woods and Plantations.*—Draining is likewise an improvement of the most essential consequence to plantations, when they do not consist of aquatic trees. Land on which it is intended to plant the common forest trees, if wet, particularly requires draining; for as the roots of trees, penetrate deeper than those of any other plants, the necessity of removing the water in the subsoil, as well as that on the surface, is evident. Where this has been attended to, the plantations thrive, and the trees grow to a considerable size, much faster than can otherwise be expected.

4. *Improvement of Wastes.*—The improvement of wet moors must be preceded by draining, stagnant water being injurious to all the valuable classes of plants. Care in particular should be taken, to render the land dry, before the application of lime, dung, or compost, otherwise the attempt will be ineffectual. At present, commons lying waste, are, in respect of drainage, in a most wretched state. The soil, in the first instance, absorbs as much water as it can contain, and the surplus water remains on the surface, in a stagnant state, highly injurious to the healthiness of the neighbourhood ([117]).

5. *Melioration of Climate.*—By the removal of stagnant water, and the prevention of noxious exhalations, the climate is rendered more healthy and genial, both to animal and vegetable life ([118]). Indeed, since the introduction of draining into this country, agues, and other similar distempers, occasioned by the humidity of the soil, and the consequent impurity of the atmosphere, have been, in a great measure, prevented; and the general health of the inhabitants has been greatly improved. Much water is discharged in the atmosphere, by spouty land, through the aquatic plants and coarse herbage which it carries; and it is a curious and important circumstance, in an experiment recorded, that while the air immediately above a wet soil, was only 57° of Fahrenheit, the dry part of the same field, and of a similar soil, was considerably higher ([119]).

6. *Miscellaneous Advantages.*—The drainage of one tract of land, may likewise furnish water, by which the accommodation of another may be promoted, for various useful purposes, as, for irrigation;—for mills, and other machinery;—for supplying houses, ponds, inclosures, canals, or artificial navigations. By peculiar modes of applying the arts of draining also, the quantity of water found in mines and quarries may be diminished, either by cutting off the resources above, or by letting down that which often impedes their working into a porous stratum below.

On the whole, there are no means by which the value of land can be advanced, or from which, when usefully applied, so many advantages can be derived, at a moderate expense, as that of draining. The owner is benefited by an increase of rent; the occupier, by that of produce; and the public, by being thus supplied with greater quantities of the most essential commodities, and by having a source of useful employment furnished to the labouring classes of the community. Unfortunately, in all parts of the United Kingdom, a great deal of land stands more in need of draining than of manuring; and there are very few districts, where a knowledge of this essential means of improvement, is so general, or so perfect, as it ought to be.

2. *On the Causes of Wetness in Land.*

To proceed with any prospect of success in the art of draining, it is necessary to ascertain the causes which produce wetness in land, and the different appearances which, according to soil and situation, it assumes. These causes are, 1. Surface-water; 2. Soils absorbing and retaining a superabundant quantity of moisture, either from their own texture, or the quality of their subsoils; 3. Land springs from surface-water; 4. Springs from subjacent water; 5. Backwater from ditches or ponds; and, 6. Floods from rivers, lakes, or the sea.

1. *Surface-Water.*—*On clay soils,* wetness is commonly produced by surface-water. These soils are of different kinds, varying both in their colour and texture; but they all possess, in a greater or smaller degree, those adhesive qualities, which retain the water that falls upon the surface, until it is either drawn off by art, or exhaled by the sun and the atmosphere. Such soils, therefore, can only be relieved from superabundant moisture, by surface-drains.

2. *Absorbing Soils.*—Loamy soils absorb water freely, and

swell with it. They usually retain, however, a greater quantity than is necessary. This is particularly the case, when they have a strong and impervious subsoil, through which no water can penetrate. As this surplus quantity is injurious to vegetation, it ought to be got rid of, either by surface drains, or what are called hollow-drains. Sandy soils, on a retentive bottom, also require draining, as the water cannot descend lower, being lodged in the upper stratum; but there is seldom a necessity, for going deeper than a few inches into the clay, on which the upper soil is incumbent.

3. *Land Springs.*—In many cases, soils are greatly intermixed, and portions of sand and clay, or substances either porous and retentive, are found in the same field. Draining, in such cases, is attended with more difficulty, and requires more skill, than where the superficial and internal strata are thick, and regularly disposed. The means by which this can be best effected, at a moderate expense, is to ascertain the quality of the soil, by examining its produce. The porous soils collect reservoirs of water, which augment in times of rain, to the full level of the surrounding clay, from which it bursts out, and forms a kind of *temporary spring*, which renders the land over which it flows wet, and unproductive. It is then perhaps absorbed by another porous stratum, which produces similar effects. Formerly, this mischief was endeavoured to be remedied by small drains, made over the whole field, which seemed thus to be equally affected; but by cutting a trench, from the nearest and lowest part of the field to be drained, up to the highest and most distant sand-bank, in such a direction, as to pass through the intermediate sand-beds, the soil is radically cured. Besides these main-drains, however, side-cuts are often necessary.

4. *Springs from subjacent Water.*—A knowledge of the causes, and the nature of springs, arising from subjacent water, is so closely connected with the principles of draining, that it is necessary to explain it at more length. The earth is known to be composed of various strata, which, from differences in their nature and qualities, have acquired the distinguishing names of *porous* and *impervious.* Sand, gravel, calcareous earths, and various kinds of rock, the parts of which are separated by frequent chinks and fissures, are denominated *porous* soils. Clay of various sorts;—certains kinds of gravel, with a mixture of argillaceous and cementing particles in their composition;—and rocks of a solid and compact nature, and without fissures, are the prin-

cipal strata that resist the admission of water, and are thence termed *impervious*. It is evident, therefore, that springs must originate from water falling, in the shape either of rain or dew, or of melted snow and hail, upon such porous and absorbent bodies; and that the water subsiding downwards, until it is obstructed in its passage by these impenetrable substances, forms reservoirs of considerable magnitude, which afterwards burst forth in all those different appearances which are met with. Thus springs are formed, the strength of which depends upon the extent of high ground which receives and retains the rain-water, the size of the reservoirs, and the supply they furnish.

5. *Back-water.*—A frequent cause of wetness is, the stagnation of water in the ditches that surround fields, particularly such as lie in the upper side of the inclosure, where the water, being confined, finds its way downwards into the open parts of the subsoil, and oozes out to the surface, forming, in wet weather, all the appearances of, and producing nearly the same effect as, a natural spring. Water conveyed in a drain, or small stream for mills, or confined in a mill-dam, or pond, has often the same effect. Where this happens in drains, the stagnant water should be removed, by giving more depth or declivity to the ditch in which it lies. Where a dam occasions the mischief, a cut should be made on its lower side, to intercept any water that may ooze through it. Old marl-pits full of water, and cattle-ponds improperly constructed, sometimes occasion this sort of mischief.

6. *Floods from Rivers, Lakes, or the Sea.*—In these cases, the proper remedy is embanking, to be afterwards explained, (Sect. II). But, in that case, the aid of machinery, is often necessary to assist in the drainage.

3. *The Sorts of Drains commonly used.*

There are four sorts of drains: 1. The open; 2. The covered; 3. The arched; and, 4. The vertical, or pit-drain.

1. *Open Drains, or Ditches.*—These often answer the double purpose of conveying superfluous water, and of inclosing the fields; though they certainly make a hazardous and inconvenient sort of a fence, without the addition of a bank, a wall, a hedge, or a railing.

In cultivated land, where the ridges are of a proper length, breadth, and height, and the furrows of an adequate depth, and skilfully directed, much surface-water may thus be carried off; but where the country is flat, and the soil peculiarly strong, a complete drainage is absolutely essential, as the basis of its future improvement. The mode practised in "*the Carse of Gowrie*," a district in Scotland, containing about 30,000 acres of rich clay and loam, has been attended with such decided success, that it may be proper to explain it, as the same system may be applied to all tracts of clay similarly circumstanced.

The proprietors, by mutual consent, fixed on the most eligible lines for cutting large drains, from fifteen to twenty feet deep, (provincially called *pows*), resembling small canals, for conveying the water collected in them to the adjoining river. 2. Ditches of a smaller size were next drawn, surrounding and intersecting the farms, so as to serve for divisions of the different fields, the water of which they collected, and emptied into the large drain or *pow*. The depth of these ditches was seldom less than four feet; their width at top, six; and at the bottom, from one, to one foot and a half ([120]). 3. Where the fields are of an uniform level surface, the common furrows between the ridges, if sufficiently clear, will keep the ground dry; but, as fields are seldom without some inequalities, the last operation, after they are sown and harrowed, is, to draw a deep furrow through every hollow in the field, in such a direction, as to communicate with the other furrows that divide the ridges, and with the ditches at the extremities of the inclosures. These cross furrows, (provincially termed *gaws* or gripes), are opened by the plough, but widened, cleared out, and shaped by the spade, to enable them to discharge the water freely ([121]). To keep them clear, is a very essential part of the clay farmer's attention. The effects of this system of drainage are such, as to render the land so free and tender, that less labour prepares the ground for the crop,—less seed is necessary,—less manure is required,—and as neither drought nor damp have any very injurious effect upon the soil, an abundant crop may be expected in all common seasons ([122]).

The necessity of making these *water-cuts*, or furrows, in wet fields, as soon as the plough leaves them, is strongly inculcated, as essential for the future dryness and fertility of the land. The cuts ought to be frequently examined, more especially after the melting of snow, to see that no impediment prevents the free passage of the water. The cutting of water-furrows, ought likewise to be carefully attended to, after spring ploughing, to prevent water from lodging in any part of the field, however wet the weather; and for that purpose, the head-lands should be cut through, where necessary, that water arising from any sudden flood, may have a free passage; the spit of earth dug out of the water-furrows, should be laid on one side, opposite to the rise of the land, to prevent overflowing, and all the loose mould carefully shovelled out ([123]). This simple operation of *water-furrowing*, is attended with such beneficial consequences, that wetness may often be removed by such means alone, without the aid of additional drains; while the omission of it, may not only lessen the crop, but injure the soil for some time afterwards.

Water-furrowing is likewise of great advantage, in pasture fields; and the cuts, or furrows, ought to be carefully scoured out before winter. The water is thus prevented from lodging and soaking into the soil;—which is then less likely to suffer from poaching;—and the roots of the grass, not being chilled by superfluous moisture, will necessarily come forward earlier in spring ([124]).

In some districts, open drains are made of the subjoined shape, and turfed to the bottom, so that there is no loss of herbage. No water ever stands in these drains, and a part of a county, (the Coventry estate in Worcestershire), which,

half a century ago, was a mere morass, has now become, by means of these drains, perfectly dry, healthy for sheep, and fit for cattle ([125]). Mr Johnstone recommends, that these drains should not be ploughed with the rest of the field, but should always remain in grass; for if loosened by the plough, the sides might be washed down, and the shape destroyed ([126]).

It is a general rule regarding open drains, with a view of giving sufficient slope and stability to their sides, that the width at top, should be *three* times as much as that which is necessary at the bottom; and in the case of peat-mosses, or soft soils, it should be still more. In regard to the fall or declivity, it should be such, as to allow the water to run off without stagnation, but not with so rapid a motion as to injure the bottom.

In all drains, it is a rule to begin at the lowest place, and to work upwards, by which the water will always pass from the workmen, and point out the level. This enables the labourers also, to work in coarse weather, and prevents their being interrupted by wet, so early in the season, as otherwise might happen. But when drains are to be filled with stones or other materials, it is proper to begin at the highest part of the drain, and proceed downward, so that the mud raised in the operation may not run in among the stones, and fill up any part of the interstices.

It is much recommended to all farmers, in low and moist situations, frequently to perambulate their farms, for the purpose of examining the state of their drains, and discovering every obstruction; nor ought even the trace of the mole, crossing an open drain, to escape their notice ([127]).

2. *Covered Drains.*—As open drains rather diminish the extent of surface, and are sometimes injurious to stock, covered drains are in many cases preferred. Here we shall consider,—The season for executing them;—The mode of doing it;—Their size;—Whether hollow or filled;—Materials for filling;—Distance from each other;—Duration;—The expense; The state of the ground;—and, The impediments and enemies they have to encounter.

1. The summer is, in general, the best season for executing such drains, because the labourers can then work with more comfort;—the materials for filling can be more easily collected;—the land is in the best state for bearing the carriage of stones;—and more work can be done in a day ([128]).

2. Drains intended to be ultimately covered, are sometimes begun to be made by the plough, as being the least expensive mode. But only small drains can be made in this way; and as drains, in general cases, ought to be at least four feet deep, spades of different dimensions must be employed. The additional expense is amply repaid, as the work is done more effectually ([129]). The trench, however, is often begun by the plough, and finished by the spade ([130]).

3. The size of covered drains, must be regulated by the quantity of water to be conveyed away. In point of width, there should only be room to work, unless, from the softness of the soil, a greater slope is necessary. An overwidth increases the quantity of materials requisite to be used in filling, which, in many situations, is an object of no small consideration. The depth should be such, as to allow a proper quantity of earth above the drain, that the materials in it, and what covers them, may not be injured by the pressure of the horses or cattle in the act of ploughing.

4. Covered drains are frequently hollow, where the run of water is large, or the materials good. This last is the case, when the drain is made of stones, either inserted in a triangular shape, or regularly built and covered by flags; or where common or draining bricks or pantiles are made use of. These are preferable to stone in two respects: they can

be more quickly and uniformly laid, and they give less interruption to water than the ragged edges of stone. Sod, or turf drains also, are not filled [133]; nor the clay pipe drains [134]. These last, however, are better calculated for small aqueducts for the conveyance of water, than for draining land; as when finished, the water can have no access into them from without.

5. The materials for partially filling drains are numerous; as, *small stones*, which answer for a considerable time, provided the drain be sufficiently wide at bottom, if stones to the depth of at least two feet are used, and they are properly covered;—*bricks* or *tiles*, which are sometimes expressly made for the purpose of draining, and are exempted from duty on that account;—*turf* or sods, which many recommend in preference to any other substance [135], and it certainly has the advantage of cheapness;—*wood*, particularly old thorns, cut into billets, which are well calculated for soft or peaty soils, that are unable to bear the weight or pressure of stone;—*green bushes*, not in leaf, (in some situations green willow is known to have lasted for ages) [134];—*black-thorn*, which is a favourite material in Essex;—*heath* or *ling*, which has been found a durable substance;—*fern*, *furze*, or *broom*;—and where the drain is small, and better materials cannot be had, even *straw*, either loose, or twisted into ropes as thick as a man's leg. The durability of the materials, at the same time, is of no less consequence in clayey soils, than the probability of having a sufficient opening for the water to flow through; for clay sometimes forms an arch over these materials, capable of supporting the incumbent soil, and leaving a clear passage for the water below when they decay. The materials must be covered with loose straw, stubble, fern, rushes or turf, before the mould is thrown in. The drains should be filled up as soon as possible after they are ready for that purpose, and by the most careful of the workmen. They should at any rate be completed before winter, for if exposed to frost, they are apt to crumble down.

6. When the soil is very wet, it will be necessary to cut the small drains near each other; from forty to fifty feet distant in common soil, and from twenty to thirty feet in the more stubborn [135]. But deep and large ditches must be cut around wet fields [136], into which the water, from the smaller drains, is to be conveyed.

7. When done with common skill and attention, drains will last for twenty, twenty-five or thirty years, and in many cases they have endured much longer. Indeed, a drain

that is properly and substantially executed, may last for ages.

8. The expense is calculated at from 20s. to 60s. per acre; except in very wet soils, where it is sometimes higher than even 60s.; but in most cases the whole of the expense is repaid by the first arable crop.

9. The best period for making these drains is, when the land is in grass, or in fallow.

10. Hollow drains have several enemies, as moles, field mice, the roots of trees, (in particular the poplar, and the ash) ([137]); and a plant which sometimes grows in them, intercepts the course of the water, by degrees weakens the current, and at last chokes up the drain ([138]).

3. *Arched Drains.*—The expense of arched drains, of stone, or brick, prevents their being adopted, unless where the ground is very loose, or where open drains are inadmissible. Where flat stones abound, drains covered by them may, in general, be made large enough, for every essential purpose ([139]).

Vertical, or *Pit Drains.*—Drains of this description may on some occasions be useful. If the spot where a confined reservoir of water exists, can be ascertained, (which sometimes may be done by boring with an auger), a pit should be sunk into the place, of such a size, as will allow a man to work within its bounds, (or about three feet in diameter), until it reaches the water meant to be brought up, which will rise, as soon as the pit reaches it. The pit should then be filled with stones or pebbles, and the water be conveyed by a proper drain, to some adjoining ditch, and thence to the nearest stream or river ([140]).

Spouts or springs also, rising in the middle of a field, may, on some rare occasions, be led into a pit sunk through the clay, aud the water may thus escape downwards, into a porous substratum ([141]).

In regard to the proper season for carrying on the operations of draining, bogs should be drained in summer, but winter and spring are the proper periods for *general draining*, because strong soils are then more easily cut, and the workmen are enabled to take true levels, from having water, (an unerring guide), which frequently cannot be obtained in summer.

4. *The Instruments employed.*

The instruments employed in draining, are more numerous than is commonly imagined. The principal are,—

draining ploughs;—the miner;—the mole plough;—spades of various sorts;—the sod knife;—and the auger.

1. The *common plough* is frequently used to open the trench; various sorts of ploughs have likewise been invented for that special purpose, and premiums given to the inventors; but from the number of horses or oxen required to work them, ploughs calculated for *effecting hollow draining*, are more expensive than the spade, and never can come into general use.

2. In Lancashire, an instrument called the *miner*, was invented by the late Mr Eccleston. It is a sort of ploughshare fixed in a strong beam, without mould-boards, and drawn by four or more horses, along the bottom of a furrow made by a common plough. Without turning the substratum, it penetrates into, and loosens the soil, eight or ten inches deeper than the plough had before gone; which operation, besides draining the land, renders the subsoil open or porous for several years, and causes the water to carry with it any noxious matters in the soil (142). This, in particular cases, is considered to be a useful practice, and the expense is inconsiderable.

3. A particular account is given, in a valuable work, of the first experiments with the *mole-plough* invented by Mr Adam Scott (143). It was originally tried in the year 1795-6, under the auspices of the Society of Arts in London. The addition of wheels was then recommended, and has since been carried into effect. The accounts of the advantages resulting from this instrument are extremely contradictory. It has no doubt been found effectual, when well applied. It will succeed, where there is a regular stratum of clay or stiff marl; but not in loose, nor in mixed soils. Without wheels, it requires from ten to fourteen horses, the trampling of which must be extremely injurious to wet soils; but with wheels, the team may be reduced to six horses (144). It is sometimes worked, with a peculiar apparatus, by manual labour (145); but it can never become generally useful, until it is proved that *a moderate power* is sufficient to impel it.

4. The spades used in hollow-draining, are of a peculiar construction. The upper, or *top-draining spade*, is narrow at the end, and the spade used for the lower part, or bottom tool, is almost pointed. A narrow scoop also is used for smoothing, and cleaning out the bottom of the drains, previous to the wood, straw, or other materials being put in. A breast-draining spade has also been invented, and is found useful: it is the common paring spade, with both sides turn-

ed up; and is driven forward by a man in the same manner ([146]).

5. *A sod-knife* ([147]) is useful in setting out the trenches, the workmen treading it in by the side of a line, five or six inches deep. It is more expeditious, and easier to the workmen, than the spade.

6. *The borer*, or auger, used in draining, is very similar to that employed in searching for coal, or other subterraneous minerals ([148]).

5. *Modes of Draining applicable to different Soils, and the Objects to which they are applicable.*

1. *Clays.*—It is a subject of great controversy, to be afterwards discussed, (Chap. IV. Sect. 1. § 1.) what is the proper breadth of ridges, in a clayey soil, with a view to drain it. The only point necessary to be here touched upon, is, whether, in clays, the drains should be open, or covered. In general, open drains are to be preferred, being less expensive to form, more easily kept in order, and more certain in their effect. At the same time, in some particular cases, covered drains have succeeded. In the Duchy of Limberg, they prefer having such drains in the furrows of strong land, by which less ground is lost, and the soil is rendered at all times accessible to culture ([149]). The celebrated Arbuthnot, (who is characterised by Mr Arthur Young, as the best farmer he ever met with, in the course of his long experience ([150]), practised that system near Mitcham in Surrey; and an intelligent Scotch farmer, (Mr James Andrew, at Tillylumb, near Perth), has carried the same plan into effect, with the greatest success. He was formerly at the mercy of every season, and found none so dry, but that in a certain degree he sustained some injury; but since he has adopted the plan of a hollow drain in every furrow, he can plough at any time; the seed can be put in, if there be but a single dry day; in the ordinary course of things he can always rely upon a crop; and the soil being nearly of the same quality, and in a similar state, the crop is always equal ([151]). In the western districts of Scotland *furrow draining* is extended to grass lands, greatly to the improvement of the herbage.

2. *Loams.*—When loams are allowed to rest, they sometimes acquire a degree of cohesion little inferior to clay. They generally absorb water rather freely, and after retaining a proper quantity for vegetation, they allow the super-

fluity to run off, where there is a descent; but that operation is facilitated by hollow-drains, water-furrows, and ditches, which, collecting the water, operate like veins, and convey it to a large drain made for carrying it off.

3. *Meadow Land.*—Along the sides of rivers or smaller streams, much valuable land injured by water is met with. Sometimes land in this situation, is protected from the overflowings of the river by embankments, as ought to be done with respect to the fine meadows in Derbyshire and Staffordshire, on the banks of the Dove ([152]); but it frequently happens, that by deepening the river or stream, or, in other cases, by making a new, straight or deeper channel, a considerable addition may be made to the land, and the object of drainage effected. Sometimes the wetness arises from springs, which issue from the bottom of an adjoining high ground. With much ingenuity, Mr Edward Webbs, of Stow, in Gloucestershire, has employed water collected by the upper drains, to drive a wheel, by which the water is pumped from the lower parts and carried off ([153]).

4. *Upland Pastures.*—The draining of upland pastures is an important branch of the subject. From the unwholesome quality of the plants produced on such pastures, where there is a superabundance of moisture, whether stagnant on the surface, or confined under it, proceed that most destructive malady, *the rot*, and other diseases, to which many thousands of valuable animals fall a sacrifice every year. In the sheep farms of the Cheviot hills, the object has in a great measure been obtained, by cutting surface-drains, about one foot wide, and as much deep, in an oblique direction to the declivity of the ground ([154]). The water collected from these drains, is sometimes employed in running over such parts of the ground below, as are dry and covered with heath, where it has the effect of killing that plant, and encouraging luxuriant grass ([155]). No mode of improvement is attended with more benefit, or occasions less expense ([156]).

5. *Bogs.*—The successful mode of draining bogs, as practised by Elkington, and so ably described by Johnstone, cannot be minutely detailed in this place; it may be sufficient to state the general principles upon which it depends. These are, 1. discovering the main spring or source of the evil; 2. taking the levels, and ascertaining their subterraneous bearings; and, 3. making use of the auger when necessary, if the depth of the drain is not sufficient for that purpose, to reach and *tap* the springs. As an example of this, it may be mentioned, that in a field near Tamworth

in Staffordshire, by boring a hole thirty feet deep, through which water issued at the rate of *three hogsheads a minute*, a great extent of wet land in that neighbourhood was laid dry. Indeed, in several cases, the Elkingtonian system has been attended with extraordinary consequences, not only in laying land dry, in the vicinity of the drain, but also by having a material effect on springs, wells, and wet ground, at a considerable distance, with which there was no apparent communication ([157]).

6. *Lakes.*—The objects in the draining of lakes are threefold: 1. For the sake of the land that may be gained, when the water is removed; 2. For the marl and rich earth that may be got at the bottom; and, 3. For the purpose of obtaining a level to drain the tracts of meadow, and marshy ground adjoining, which cannot otherwise be accomplished. In this way, the climate in the neighbourhood may likewise be improved. In many cases, such pieces of water have been either partially or entirely drained by deep cutting solely, but sometimes the aid of machinery is required.

7. *Land-locked Bogs or Morasses.*—In several parts of the kingdom, there are tracts of this description, which become wet by an accumulation of rain water, stagnating on an impervious subsoil, through which it can have no descent, and incapable of being drawn off by the surface, being surrounded by higher ground, through which there is no vent. The proper mode of draining these land-locked bogs is, by perforating the impervious bed of clay, on which the water rests, if any such exists, and letting the water downwards into a sandy, or other porous stratum ([158]). This plan will succeed, where there are any beds under the clay, through which the water may have an outlet.

8. *Mines and Quarries.*—In many cases the workings of mines and quarries are obstructed by a flow of water, which, by attention to drainage, may be either entirely removed, or diminished, before it reaches the mine or quarry. For that purpose, it is necessary to drain all ground lying higher than, or contiguous to, subterraneous pits and mines. The water that gets into the pit, may, on some rare occasions, be got rid of, by boring through the close or impervious bed, to the absorbent strata below.

It may be proper here to observe, that Elkington's mode of draining, has not been so successful in Scotland as in England. This, however, does not proceed, from any defect in its principle, but from local circumstances. In the champaign districts of England, where the strata are regular, and the beds of sand, clay, &c. extend, with but little interruption, to considerable distances, the soil may be drained on the Elkingtonian plan; but in Scotland, where the strata are much more frequently interrupted by the convulsions of nature, that mode of draining cannot be equally successful. Hence, as the springs rise at various places, each must be drained according to its own local and relative circumstances; and the drains must be so extended, and formed of such depth, as to catch every spring, whether it is small or copious.

Concluding Observations on Draining.

So sensible are landed proprietors become, of the deep interest they have in executing this most important species of improvement, on a liberal and extended scale, that it is a practice with many, to have a *general plan* for the drainage, and regular division of the different farms, when their estates are newly let; thus availing themselves of an opportunity, to have the plan executed in a methodical, substantial and permanent manner, under professed drainers and labourers, solely employed in this essential work ([159]). On this great scale of drainage, the connexion of one farm, or part of an estate, with another, renders the effect more complete, and the ultimate charges much less. Indeed, so sensible are the tenants of the advantages of this system, that they give it a preference, to that of having the work done at their own expense, and in their own manner, even with the certainty of indemnification ([160]).

While such are the advantages to be derived from draining, it is unfortunate that any obstacles should exist to the execution of such a useful improvement. Unless Parliament, however, will direct its attention to the subject, and enact regulations for the encouragement of draining, the efforts of private individuals will often be checked, and much valuable land will continue unproductive. A more complete exemption from the tax on draining bricks, would be of great use. A law might also be passed, authorising proprietors, even on entailed estates, to charge their land with three-fourths of the expense of drains, as they can at present in regard to inclosures; and to compel the neighbouring proprietors, to share in the expense of draining, if they derive any benefit from it, as is the case in Scotland, when fences are made on the boundaries of different estates.

The laws of a nation ought to be improved from time to time, to keep pace with the accessions of knowledge which the people acquire, and with the necessities of the country, as it becomes more populous. The Code of Rural Legislation of Great Britain, unfortunately, has not improved in the same ratio with its increased population, and thence it is as little calculated, for the number of its inhabitants at this time, as its produce a century, or even half a century ago, would now be sufficient for their maintenance. It is not here meant, that the law should interfere with the rights of private property, farther than the public good absolutely requires. More effectual regulations, however, for promoting cultivation, drainage and inclosure, ought now to be enacted, the existing laws being imperfectly calculated for promoting these essential improvements ([161]).

Sect. IV.—*On Manures.*

INTRODUCTORY REMARKS.

The term *manure*, includes all those substances, which, when artificially applied to, or blended with the soil, are known from experience to restore, to preserve, or to augment its fertility, or to render it, in any other respect, more favourable to vegetation. This includes all the articles, which tend to correct any noxious ingredients in the soil, or to turn to greater utility, certain substances previously contained in it ([162]).

Before entering, however, into the subject of manures, it may be proper briefly to state the various modes in which they are applied; as, 1. Mixing them with the soil; 2. Laying them carefully in drills, and sowing the crop upon them; 3. Top-dressing, or scattering them upon the surface; and, 4. Converting them into a liquid form. The plan of making them up in composts, shall afterwards be discussed.

1. *Mixing manures with the soil.*—This is by far the most general mode of application, where dung can be had in considerable quantities; and it is the best system to be adopted, in all cases where it is necessary to enrich a field, for a succession of exhausting crops. But it is questionable, whether it is the best means to make the most of the manure collected, as some of its most valuable parts, may be ploughed in deeper than the roots of many vegetables go, and in some cases, they may be entirely washed into the earth, and lost.

2. *Manuring in drills.*—This mode is used in the culture of particular crops, as potatoes, turnips, and the like, and its advantages, in such cases, have been decidedly ascertained. The plants sown upon the manure applied in this manner, receive the whole benefit of that substance, in all the stages of its growth; and if the land is afterwards ploughed cross-ways, and well harrowed, what remains of its strength and substance, is incorporated with the soil, for the benefit of future crops. It is asserted by some friends to this system, that the quantity of turnips and potatoes produced by following this plan, on very indifferent soils, and with a small quantity of manure, will sometimes equal what a rich soil, with a great quantity of dung, will yield.

3. *Top-dressing.*—This mode of application is chiefly intended to promote the growth of vegetables, and not with a view to improve the soil. It is principally confined to manures distinguished by the smallness of their bulk, as soot, rape-cake, pigeons'-dung, peat-ashes, &c. Top-dressings are used with great effect, when crops are sickly, and backward in the spring, occasioned by a bad seed time, frost, or other causes. The crops are thus enabled to vegetate quickly, to spread out new roots, or tiller, and to protect the soil, on which they grow, from the ensuing droughts of summer.

In favour of top-dressings, it is contended, that when a considerable quantity of any manure is mixed with the soil, a great proportion of its richest salts, and other properties, will be carried down by the rains, and by that means, will not only be lost to the present crop, but if the subsoil be of a loose and porous nature, will very soon escape beneath the reach of the plough; whereas, if manures were strewed on the surface, they would sink by slow degrees, their beneficial effects would be exerted upon the roots of the plants, in their passage downwards, and very little, if any of them, would penetrate deeper than they could be useful. These arguments are used, in favour of applying a top-dressing in the shape of fermented dung to grass-land, both for pasture or hay, though a considerable portion of its value is apt to be lost by evaporation, unless the season is rainy.

The practice of top-dressing is adopted by many of the most intelligent farmers in the island, particularly those of Berkshire, Bedfordshire, the West Riding of Yorkshire, &c., and experience has fully convinced them, that no other mode of applying manure is equally profitable. In Hertfordshire, the plan is practised with peculiar attention and success; and to it, the farmers of that country are indebted, for their large and almost never-failing crops ([163]). As a top-dressing for a crop of wheat likely to fail in spring, it is strongly recommended, to apply two lbs. of common nitre, mixed with three bushels of earth, per statute acre.

4. *Liquid Manures.*—In Switzerland, they are impressed with a high idea of the advantage to be derived from a liquid manure to which they give the name of *liziers*, or *lizèe*. For the preparation of that article, reservoirs are erected in the neighbourhood of the cow-houses, the dung of cattle being peculiarly fitted for the purpose. As soon as their excrements are dropped, they are carefully conveyed to the reservoir, and thrice the bulk of water thrown into it at the same time. A fermentation soon takes place in hot weather, and in about four or five weeks, even in cold weather, the process is completed. The manure remains for some time, in a state fit to be used. If kept, however, beyond nine or ten months, its useful qualities are destroyed by another fermentation. When fully matured, it is carried to the field, and scattered over it. The earth immediately imbibes the liquid, which soon reaches the roots of the plants, and causes a rapid vegetation; whereas it is a long time, before dung in a solid state, fertilizes the soil. This manure is particularly calculated for lucerne and clover; and it is so generally employed in Switzerland, that many districts of that country are said to owe their fertility principally to its use. From the labour, however, attending the plan, it does not seem calculated for large farms, or general adoption ([164]). In Flanders also, urine, in which rape cake has been dissolved, after being fermented in large cisterns made with brick, is conveyed to the fields, where it is spread by means of scoops, and found highly beneficial.

It is well known, that the grass land on which flax or hemp is put to be dried, after they have undergone the process of watering, is greatly improved, from the putrid fertilizing substances which they yield. This furnished a hint to an intelligent agriculturist, (John Billingsley, Esq.) to try the effects of flax water, which he applied to pasture lands, by means of carts, similar to those used near London in watering the roads. The effect was astonishing, and advanced the land in value ten shillings per acre. The haulm of potatoes might be inserted in ponds, with similar effect. Mr Billingsley considered this liquid to be much superior to animal urine.

In Devonshire, ponds are enriched by the drain of an adjoining farm-yard, with the addition of an occasional bag of lime. These ponds, to which they give the name of '*Presidents*,' furnish a most valuable manure.

On a Mixture of Soils.—It may be proper to conclude this branch of the subject, with some hints on the advantages derived from a mixture of soils, by which their texture may be greatly improved, and the manures applied to them, may be rendered much more useful. By a proper mixture of light earth, sand, or other coarse and incoherent substances, stiff soils, which water can hardly penetrate, may be so opened and subdivided, as to admit freely a quantity of moisture, and other nutritive matters, sufficient for the nourishment of plants; while light soils, on the other hand, by being incorporated with clay, are rendered more retentive both of moisture and of manures, and the vegetables produced by them, are enabled to take such a hold of the soil, from their superior tenacity, that they attain much greater perfection. In the most fertile soils, however, sand is the most essential ingredient, to the extent of from 50 to even 60 per cent. The great fertilizing virtue of sand, arises from its allowing *both air and water* to penetrate to and reach the roots of vegetables, of which they form such essential ingredients.

In discussing the subject of manures, attempts have been made by various authors, to arrange these substances in a philosophic manner, and to explain their properties on chemical principles. In this work, restricted to practical information, it is proposed to classify them under the general heads of Putrescent;—Calcareous;—Earthy;—Vegetable;—Miscellaneous;—and those mixtures of various substances, known under the name of Composts.

1. *Putrescent Manures* ([165]).

These unquestionably are the most important of the classes above enumerated. They not only supply the soil directly with the principal sources of fertility; but having a tendency to produce a strong germination early, plants have thence a better chance of reaching maturity. Putrescent substances, being of a nature susceptible of decomposition, are ultimately exhausted, when the soil has yielded crops for any course of time. It is necessary therefore to replace them; and the articles which may be employed for that purpose, are comprehended under the following heads: The dung of quadrupeds;—the dung of birds;—town dung;—night soil;—urine;—land animal substances;—fish;—and fish oil.

1. *Dung of Quadrupeds.*—This valuable substance furnishes immediate food to plants;—excites heat in the soil;—opens its texture;—attracts and retains moisture;—and promotes the decomposition of vegetable particles in the earth, by the fermentation which it occasions. Where animals chew the cud, the dung is so thoroughly reduced, that it may be incorporated with the soil, without requiring to be collected in a dunghill; but on various accounts, a mixture of hot and cold, of dry and moist putrescent substances, in the same heap, is found to be advantageous.

The subject of farm-yard and stable dung, practically considered, includes the following particulars; 1. Collecting the materials, 2. Preparing them for use; and, 3. Applying them to the soil.

1. *Collecting the Materials.*

1. Farm-yard dung consists of the excrements of various animals, mixed with their litter, and such other absorbent articles, as are calculated to increase the quantity, without injuring the fertilizing quality of the mass. Even weeds of all sorts, may with safety and advantage be collected for that purpose in summer;—also leaves of trees, or of shrubs, which are often to be obtained in considerable quantities in autumn;—straw, and chaff, not used as food or litter;—likewise vegetable mould, or peat earth.

2. The most essential article, however, is the excrements of domesticated animals. Of these, the dung of the hog, owing to the nature of its food, is the strongest and richest;—that of the horse, the driest and most heating;—that of neat cattle, the coldest, but the most lasting ([166]). The dung of sheep is seldom mixed with other articles, and being only calculated for immediate use, is soon exhausted.

3. It frequently happens, that the dung of horses is separately used, particularly when taken from towns; but in farm-yards, there is an opportunity of mixing cattle, horse, and hog dung, which is always to be preferred, as the one corrects the defects of the other, and prevents the fermenting process from going too rapidly forward. These substances should be laid, *stratum super stratum*, which can easily be done every day, when the stables, cow-houses, and

hog-styes are cleaned out [167]. If a small quantity of earth or moss, can be put between each stratum, so much the better.

4. The quality of the dung of every animal, will in a great measure be proportioned to the richness or poverty of its food [168]. Hence the dung from the stables and cow-houses, is preferred to that of young cattle kept in the farm-yard, on food of a less nourishing quality. It frequently happens, however, that where stock is kept in sheds, or *hammels*, connected with the farm-yard, and liberally supplied with turnips, carrots, and other nourishing articles of food, dung equal to any to be otherwise obtained, is procured.

5. Next to animal excrement, straw is the chief material of a dunghill; and too much attention cannot be paid to collecting it. For that purpose, the greatest care is taken by the diligent husbandman, to cut his crops low. When reaping is carelessly executed, it has been calculated, that one-fourth part of the straw is left upon the ground, where its strength and substance is wasted, by the rains and storms of autumn and winter; whereas, by attention to the reaping process, one ton, and even more, of additional manure, per acre, may be obtained [169]. The value of straw is great, not only in consequence of its own substance, but from the quantity of liquid matter which it absorbs. By an experiment carefully made, it appeared, that dry wheat straw, by absorption, had increased in weight, from 300 to 719 stone, making an increase of not less than 419 stone, during a period of seven months [170].

6. It is a good rule, to lay a stratum of peat,—mould,—marl,—chalk,—scourings of ditches, and other earthy substances, on the surface of the farm-yard, before the dung is collected, in order to absorb those valuable juices that otherwise might be lost [171]. This forms a rich compost at a small expense. It should be turned and mixed soon after the cattle are removed out of the farm-yard. It will thus be brought into a most advantageous state, either for being spread upon the grass land in October, or on the arable land, as a top-dressing in spring.

7. As in heavy rains, notwithstanding every precaution, some water will run from the yard, there ought to be a covered reservoir to receive it, so situated, that the liquid can either be pumped upon the dunghill, if it requires it, or upon heaps of earth, collected for that purpose [172]. The stables and cow-houses ought also to be regularly washed, as is done in Flanders; and much useful matter might in this way be collected, and conveyed to the reservoir. Where

land lies conveniently beneath the farm-yard, the contents of this reservoir, or the overflowings of the dung-yard, may be conveyed to it, for the purposes of irrigation ([173]).

2. *Preparing the Materials for Use.*

On this head there is a great diversity of opinion; some contending, that dung cannot be used too soon after it is made; and others, that it cannot be too much rotted. The various circumstances of climate, soil, and crops to be raised, render different practices equally proper.

Much depends upon the climate. The farmers of Picardy, and other parts of France, for instance, may find *the continual carrying their dung* to the field practicable, but this cannot be accomplished in less favourable climates. What is found beneficial in warm climates, may not answer in a cold one. Besides, in wet soils and cold climates, when the dung is bestowed only in small quantities, so little of it is kept together, that fermentation in the ground is retarded, until it is too late to be of any material use to the crop sown with it.

The advantage of using fresh dung, must also depend upon the soil. Practical farmers are in general of opinion, that long dung is more applicable to strong, than to light land; and as it has a tendency, by its fermentation, to divide and to loosen the constituent parts of the soil, and furnishes matter which prevents the particles of clay from coming into contact, and adhering together, it must necessarily have a much more desirable effect on soils that are too compact, than on such as are already too light and open ([174]). Hence it is recommended, on a true *carrot soil*, to use dung, after all its parts are dissolved, and incorporated into one complete mass, by means of putrefaction ([175]).

In regard to the crops, it is remarked by Sir Humphry Davy, that straw fermented, is a more manageable substance, *and furnishes more manure for a single crop*, than unfermented. In the latter state, it decomposes more slowly, and consequently, though its influence will be more lasting, yet it produces at first, less effect. But in the case of turnips, under a proper rotation, the first crop is all that it is necessary to manure; the dung given to that crop, more especially when the crop is consumed upon the land, being the means of fertilizing the whole course of succeeding crops, whether barley, clover, wheat or oats. Besides, when dung is fermented, the seeds of weeds, and the eggs or larvæ of insects, are destroyed.

For raising potatoes, the dung of horses alone, from its heating quality, may perhaps be used nearly fresh from the stables, as it will ferment in the ground. It is this dung *alone*, that some practical farmers mean, when they talk of fresh dung ([176]). But in a cold and wet climate, dung ought to be moderately fermented, before it is inserted in the ground. The utility of fermented dung is proved, from the little advantage derived from what is dropt upon the ground, and has not undergone that process.

Some farmers are of opinion, that stable-yard manure, should never be stirred, till finally carted to the field, and deposited in the soil, for that every time it is stirred, its finest and most valuable parts escape into the atmosphere. But few occupiers are possessed of stock sufficient, to manage the manuring of a large farm on this system, and at the same time to carry on the operations of ploughing, harrowing, &c. It is therefore thought most expedient, to remove the dung, from the yard in which it has been collected, and to place it in heaps near the fields where the crops are to be sown ([177]). This may be effected, either, 1. Early in the season; or, 2. Late in spring. The plan of management should vary in these different cases.

1. *Early in the Season.*—When it is expedient to remove the dung to the turnip fields, early in the season, large quantities of clay, marl, or such other substances, should be collected for the reception of the dung heaps. The bottoms for these heaps, should consist of from six to eight inches of these materials, and the dung should not be thrown loosely upon them, to cause fermentation, but the carts, with their loads, should be drawn upon the heaps, for the purpose of compressing the dung, and thereby *preventing fermentation*, until the proper period arrives. The dung should be spread regularly, so as to render the ascent easy for the succeeding teams, as they come with their loads. When the heap is completed, it should then be covered with marl, clay, or earth, so as effectually to inclose the dung heaps, *in crusts*. The dung is thus preserved in *pies*, (as these heaps are called,) without loss from exhalation or evaporation, and in an unfermented state. By this means, the rising vapour is caught, and the volatile matter retained, which would otherwise be lost. A fortnight before the manure is required for the turnip grounds, these pies ought to be carefully turned over, and thoroughly mixed. They should be again covered with earth, when a fermentation will take

place, by which the compost is brought into an excellent state of preparation as a manure for turnips ([178]).

2. *Late in Spring.*—When the dung is taken out of the yards, only a short time before it is wanted for the turnip crop, bottoms should be prepared, as formerly directed; but the dung should not be carted upon the heaps, to compress them, and to prevent fermentation, but should be thrown up lightly with the fork, upon the bottoms, so as to favour it. The heaps, when completed, should be covered with earth; and they will soon take a gentle fermentation, and be ready for use ([179]).

It is now generally admitted, that when turnips are sown in drills, rotten dung, recently applied, greatly promotes the success of that crop. The bulk of the manure is certainly diminished, but the expense of its conveyance, and the labour of depositing it in the ground, are lessened, and it is rendered much more manageable. Above all, the speedy germination on the plant is greatly promoted, by which it stands a better chance of escaping the ravages of the fly.

In the Netherlands, the greatest possible attention is paid to putrescent manure. The more opulent pave and line with brick the receptacles for their dung, which is thus kept constantly plunged in a mass of liquid matter. The fibrous parts of the vegetables are thus completely decomposed, and four tons of this manure, will go as far as five, collected and kept with less skill and precaution.

3. *Mode of Application.*

Dung is applied to,—Fallows,—Green crops,—Corn crops—or Grass. This last mode of application will be noticed, when the subject of grass lands is treated of.

1. Strong soils, not in a high state of fertility, when subjected to the fallow process, are manured with dung; and if the land is *thoroughly cleaned*, the dung may be applied, with more advantage to the occupier, during the fallow, than in any other stage of the rotation, provided it is completely incorporated with the soil, with as little delay as possible, after it is taken from the cart. It is the worst of management, to allow dung to be much exposed to the sun, or drying winds; for the rays of the sun exhale much of the richest qualities of the dung, and drying winds destroy its value and utility.

2. The best application of farm-yard dung, in the case of light soils, is to green crops of every description, more es-

pecially, when the manure is placed in the centre of the drill, to crops of turnips or potatoes ([180]). In Flanders, they have a practice which is attended with nearly similar effects. After the dung is spread on the surface of a field to be ploughed, and a furrow has been made, a person with a fork or a rake, goes before the plough, and throws from the surface, into the furrow, as much manure as has been placed upon the soil that the plough will turn over *the next bout.* The dung is thus put at a proper depth, and is not liable to evaporation.

3. Farm-yard dung is likewise applied to clover stubbles upon which wheat is to be sown; that crop requiring the land to be in a very fertile state. In some districts, the clover stubble is likewise manured for oats.

The quantity of dung to be applied is an important question. Formerly too much was given, and the crops were surfeited with a profusion of nourishment. According to modern practice, only as much is furnished at one time, as will fertilize the ground, and render it capable of producing good crops, until a fresh supply can be administered ([181]). Formerly, from twenty to thirty tons were given per acre, whereas, now, one-half of that quantity is found to be sufficient ([182]). It was formerly supposed, that putrescent manure was durable, in proportion to the quantity applied, without considering that a great quantity rather accelerates than retards decomposition, and that the consequence must necessarily be, unprofitable fertility the first year, and disappointment during the succeeding ones. A happy medium, however, ought to be kept in view; for manures ought not to be applied too sparingly. If dung to the value of only L. 1 or L. 2 per acre is given, it may not refund the expense; whereas, by laying out at the rate of L. 3 per acre, the profit may be considerable.

Whatever quantity is used, the dung should be spread equally, and divided so minutely, that every part of the ground may receive an equal supply ([183]). This cannot be done so very equally, when the manure is laid in drills, for crops of turnips or potatoes. But even in such cases, the rule ought not to be neglected, so far as it is practicable. To promote that equal division, the drills are sometimes drawn across the field, and at other times diagonally; or, by cross-ploughing, after the crop is taken up, the dung in the drills is mixed with the soil.

The last point to be considered is, the depth at which the dung ought to be placed. If applied to grass land, it can only be spread upon the surface, and all the advantage which in that case can be derived from it is, the fertilizing matter washed down by the rains. When applied to arable land, it is strongly recommended to cover the dung well. But here, as in every thing else, extremes ought to be avoided. Dung is of use to plants, either from the gases which it emits, or by the nourishment which it furnishes to them, when in solution with water. The gases will rise, and it is of less consequence, in that respect, to what depth the dung is put; but a solution of dung in water *will sink*, and ought not to be placed beyond the reach of the roots of the crops for the nourishment of which it was intended.

The superior importance of dung from the farm-yards and stables, (which is justly denominated, the farmer's *sheet-anchor)*, has rendered it necessary, to dwell on that subject, at greater length, than is practicable in regard to any other species of manure, consistently with the intended brevity of this publication.

It now only remains, under the general head of dung from quadrupeds ([184]), to mention that of sheep.

Sheep Dung.—This valuable article is collected in several ways. In various parts of the Continent, sheep are kept in houses during almost the whole year, for the sake of their manure. When they are fed along the sides of roads, young children are employed to collect the dung which they drop. Sheep fed on upland pastures, are folded in the vale on arable land; and when crops of turnips or of rape are grown, these useful animals are folded upon the crop, which they consume upon the ground, and enrich the soil with their dung and urine. Sheep fed on lintseed-cake, produce dung of extraordinary power, by which any poor land, whether it be arable or pasture, may be speedily enriched. A most useful plan has recently been adopted, that of folding sheep upon straw in the corner of the turnip field, and carrying the turnips to them ([185]). This is particularly suitable for such soils as are too wet or tenacious to have turnips fed upon them; or on sloping grounds, where the manure might be washed down.

This plan ought always to be adopted with the flock at lambing time, not only on account of the manure produced, but for the safety of the lambs, many of which, when dropped on the cold ground, in wet weather, even in sheltered situations, die, or become crippled in their joints, whereas a layer of dry straw can be daily applied to the fold, and no loss of life need ensue, even in the most inclement season.

It is a good practice in husbandry, to fold sheep or lambs on clover, to be followed by wheat. They should have a piece of fresh feed set out for them every day, and should not be close penned, but allowed to fall back upon the land previously gone over by them. Sheep not only thrive well with such treatment, but a good succeeding crop of wheat is insured.

The advantages of folding sheep, from hilly pastures, on low grounds, has been much controverted. It is contended on the one hand, that the advantages arising from the immediate application of dung and urine to any soil, and of treading to a loose one, are so well known, that no doubt can be entertained of the profit of the practice. Indeed, on many light soils, more especially chalk, very little wheat would be raised without it; and the manure which, scattered over a large surface, would be of little or no use, when collected, proves highly beneficial. It is calculated, that 1000 ordinary sheep when folded, will manure an acre in a night. On the other hand, the profit of such folding is denied; and it is maintained, that such a system is pernicious to the sheep pasture, and injurious to the animals. To manure one hundred acres of arable in the vale, two or three hundred acres of pasture, it is said, are deprived of any benefit from manure, in the hills. The profit of the fold is reckoned only worth about 5s. per head per annum; and it is contended, that the animal, even with little driving, is injured by the practice, nearly as much. One advantage of folding, however, is, that the wildest sheep are rendered much more docile, feed better, and afterwards are more quickly fattened when prepared for the market. The introduction of this mode of folding, has been strongly recommended in the mountainous districts of Scotland, where the pasture on the hills is abundant, and provision for winter feeding is scarce.

The Southdown sheep, are found to be the best adapted for folding, both from their docility of temper, and their capacity for travelling. Their short compact wool also, probably subjects them to less inconvenience, from laying upon ploughed land when wet, than the long open fleece of the Leicester sheep. In these respects, the Cheviot breed certainly rival the Southdown.

In regard to the benefit of manure from sheep, to a hill pasture, it is not so great as may be imagined. They are always found to collect to some favoured spot at night, which is rendered perniciously rich, while other parts of the pasture derive but little benefit, except while they are eating over it by day.

2. *Dung of Birds.*—This head refers to the dung of pigeons, domestic fowls, and sea-birds.

Pigeons' dung certainly possesses much fertilizing power. It readily ferments when moist; but is generally applied in as fresh a state as possible, in gardens to onions, and in fields, to crops of wheat or barley; in which case, if mixed with peat, twenty bushels per acre are sufficient. The dung of pigeons is peculiarly excellent for carrots, as it prevents the attacks of vermin. The dung of domestic fowls, ought to be carefully collected in the poultry house or yard, for it resembles pigeons' dung in its effects. But the most valuable article of this sort is, the dung of sea-birds, which live upon fish. This substance is produced in such quantities upon some small islands in the South Sea, that fifty vessels are annually employed, to bring it for the purpose of fertilizing the sterile plains of Peru. It is there called *quano.* If the rains of our climate, are found to injure this manure on the rocks and small isles on our coast, yet it may be obtained in great perfection in caverns or clefts, resorted to by cormorants, auks and guillemots, and other water fowl; and in the West Indies, it may be collected on rocky islands, equal to that used in Peru ([186]).

3. *Town Dung.*—This is an important article, yielding, in many cases, a considerable revenue to the towns, besides fertilizing the neighbourhood ([187]). In large cities, the quantity to be obtained is enormous, though it is to be lamented, that too much of it is thrown away and neglected. In London, it is estimated, that the annual produce may amount to 500,000 cart loads, being only *a part* of the manure collected, by sweeping 3000 acres of pavement in streets and market places, and the dung produced by 30,000 horses, 8000 cows, and now, including the environs, nearly a million and a half of inhabitants ([188]). The sweepings of streets afford a species of manure, the effects of which are immediate, but not very durable. The dung produced by the cows and horses maintained in towns, if attention be paid to the preparation, is particularly valuable, as the animals by which it is produced, are generally maintained on food of the richest quality. That of horses being apt to become too dry, ought to be regularly removed, and mixed with other substances.

4. *Night Soil.*—This is the richest of all manures, and if dry, the cheapest ([189]). It is not only more quick in its ope-

ration than any other dressing, but supplies a greater abundance of food for plants. Three or four cart-loads are sufficient to dress an acre for the first time, and afterwards two loads per acre would keep it perpetually in heart ([190]). It may be spread with peculiar advantage on grass lands, after the hay is cleared away in October. Its disagreeable smell may be destroyed, by mixing it with earth, sweepings of the streets, or quick-lime. In China they make it into cakes, with one-third of its weight of rich marl ([191]).

This is the only species of manure, which, owing to its richness, and the variety of substances of which it consists, will produce crops of corn almost without intermission; but even where it can be had in abundance, an occasional intermission, and the introduction of crops of grass or roots, are advisable.

5. *Urine.*—Every sort of urine contains the essential elements of vegetables in a state of solution ([192]). That of a horse, being so much lighter, and less bulky, would be more valuable than its dung, were both to be be conveyed to any great distance. The urine of six cows or horses, made in one year, will enrich a quantity of earth, sufficient to top-dress one English acre of grass land; and as it would require three pounds worth of dung to perform the same operation, the urine of a cow or horse is worth about 8s. 6d. per annum, after allowing 8s. per acre, as the expense of preparing the compost. Urine is much improved by powdered rape-cakes thrown into the cisterns where it is kept. The advantages of irrigating grass lands with cow urine, almost exceed belief. Mr Harley of Glasgow, (who kept a large dairy in that town), by using it, cut some small fields of grass five or six times in a year, and the average of each cutting was fifteen inches in length ([193]). As this article is of a scorching quality, in seasons of great heat or drought, it is unsafe to apply it to growing crops. Hence it is unadvisable to use it, except to pasture, after the month of April or May, unless diluted. It is particularly useful in spring, when the application of liquid manure, gives a new impetus to the plant, and makes it grow more vigorously ([194]). Newly planted cabbages are forced by this manure in a most remarkable manner ([195]). This valuable production, is too often suffered to flow away, without any attempt to collect it, either for throwing it over the dunghills, or for the purposes of irrigation ([196])

6. *Land Animal Substances.*—These form a numerous and valuable class of manures. In general, they require to be blended with earthy substances, that a too rapid decomposition may be prevented ([197]).

Much useful matter of this description is lost: for instance, if animals which have died of old age or disease, were covered with five or six times their bulk of soil, mixed with one part of lime, the earth would, in the space of a few months, be so impregnated with soluble matter, as to be rendered an excellent manure ([198]). Besides preventing a nuisance, the putrifying flesh would be more valuable to the farmer, than if sold for dogs' meat.

Much manure is got from the offals of butchers, and the blood and other substances that are collected in markets. The *graves*, or refuse of tallow-chandlers, are likewise excellent for turnips, and will produce good crops of corn on the poorest soils. Every attention ought to be paid, to the collection of such useful articles, which, at present, are too much disregarded.

The use of bones as a manure, has become an object of such immense consequence, that it is proposed to make it the subject of a separate discussion, in the Addenda, (No. 1.)

Every species of animal offal or refuse will act as a manure; as, 1. *Woollen rags*, chopped in small pieces; from 5 cwt. to 12 cwt. to be used per acre. They are best for dry, sandy, or chalky ([199]) soils, as they attract moisture from the atmosphere, and retain it. 2. *Curriers' shavings, furriers' clippings*, and *leather rags*, are likewise calculated for dry soils; the quantity required is about thirty bushels per acre. 3. *Horn shavings*, equally applicable to all soils, worth about 1s. per bushel, thirty of which are sufficient per acre. 4. The *scrapings of sheep trotters, calves' feet, &c. hog's hair, feathers* ([200]); and in short, all sorts of animal substances should be collected, and, if ploughed in, will increase the fertility of the soil.

7. *Fish.*—Along such an extent of coast as Great Britain and Ireland possesses, much advantage might certainly be derived from fish as manure. In the fens of Lincolnshire, Cambridgeshire, and Norfolk, the small fish called stickle-backs, periodically swarm in the rivers to such a degree, that they may be purchased at from 6d. to 8d. per bushel, and applied in forming composts. Herrings, sprats ([201]), and the fish called sea-dogs, (after the oily parts are taken out), are managed in the same way. The refuse of the pilchard fishery in Cornwall, never fails to give great crops wherever it is spread. Whale-blubber offal also, is frequently applied to this use, and with the greatest success. Such manures minutely divide the particles of the soil, and are highly beneficial to newly broken-up barren soils. The offal of fish is found peculiarly calculated for raising cabbages; and that valuable

manure cannot be more usefully employed. It is calculated, that if fish could be obtained for L.10 per ton, it would be the cheapest of all manures, for if mixed with earth, that quantity would manure five statute acres.

Fish Oil.—No kind of manure has better claims to the attention of the farmer, and has received so little, as oil. The advantages which may be derived from its use, have been completely ascertained, and cannot be too strongly recommended to the attention of the farmer. Even a small quantity will enrich a large mass of dung or compost, or any medium by which it may be applied to the soil. Its effects, also, are immediate. When judiciously applied, it is perhaps the cheapest and safest substance that can be employed for a crop of turnips, which, on light soils, is the basis of successful agriculture. Its efficacy was tried, by mixing 20 bushels of sifted coal ashes, and 2 gallons of whale oil, and comparing the turnips produced by that mixture, with a crop that had been manured with 20 cubic yards of dung. The progress of vegetation in both crops, was nearly the same. The leaves of the turnips manured with dung, were rather more luxuriant, but no difference could be observed in the bulk of the roots.

The comparative expense of the two manures was as follows, per statute acre:

		Per acre.
20 cubic yards of dung, at 6s. per yard,		L. 6 0 0
32 gallons of oil, at 2s. 4d. per gallon,	L. 3 4 8	
Expense of ashes or fine mould,	0 16 0	
		4 0 8
Difference in favour of oil per statute acre,		L. 1 19 4

The use of oil as a manure, is likely to be productive of the following important advantages: 1. With such a command of manure, abundant crops might be raised upon soils which are now considered unfit for cultivation. 2. Besides being less expensive than dung, oil manure may be of use, by checking the attacks of the fly on turnip, and destroying vermin in the ground. 3. With this manure at command, a great addition may be made to our rural population, and immense numbers employed in the cultivation of the soil, who are now devoted to the precarious and unhealthy employments of manufacturing industry; and, 4. It would greatly encourage the whale fishery, and furnish employment to a number of ships and seamen, objects of much moment to a country, to which naval power is of such essential importance.

I hope therefore, that a number of friends to agriculture will give this species of manure a fair trial, so as to place its importance and practicability in so striking a point of view, as to promote its general adoption.

Impressed with an idea of the utility of oily substances as a manure, an eminent agriculturist, (Captain Barclay,) has mixed whale-blubber with moss, and has found it a most beneficial process. He formed a mound of moss, 36 yards long, 5 yards broad, and 4 feet high, and mixed with it 18 tons of blubber. He afterwards added from 70 to 80 tons of dung to forward the fermentation. The expense of this manure was only about L. 2 per English acre.

Mr William Bell, of Queen Street, Edinburgh, has likewise made some very spirited and successful experiments, to convert moss into a manure, by the application of *dregs*, or coarse whale-oil. To make the moss ferment, 90 cubic yards of dung, with 2 tons of that oil, were mixed with 900 cubic yards of moss, and it was proved to be a most valuable compost. The crops of turnips were abundant, while the expense was greatly inferior to that of dung ([202]).

2. *Calcareous Manures.*

This important class of manures, is more generally and more correctly applied in this country, than in any other. It comprehends a number of articles, as Burnt or calcined limestone;—Pounded limestone;—Limestone gravel;—Chalk;—Marls;—Sea-shells;—Coral;—Soapers' waste;—and Gypsum.

1. *Burnt*, or *Calcined Limestone.*—Under this head may be considered, 1. The advantages of this manure; 2. Its disadvantages; 3. The principles on which the fertility produced by lime depends; 4. The several sorts of limestone; 5. The mode of preparing it for use; 6. The application; 7. The expense; 8. The effects; 9. The rules for its management; and, 10. Some remarks on the difference between *caustic* and *mild* lime.

1. *Advantages of Lime.*—Though there are exceptions to the rule, yet in general, it is confidently asserted, that unless when a soil has by nature enough of calcareous matter in its composition, for the purposes of vegetation, it can neither be brought into its most fertile state, nor will other manures be so useful as they would prove, if lime, or some other calcareous earth, be not previously applied ([203]). When lime is spread upon a moory soil, either naturally dry, or properly drained, good herbage is produced, where nothing but heath, and unpa-

latable grasses grew before [204]. By the same means pastures, instead of being ruined by fog, or yielding nothing but bent and other inferior grasses, have been covered with herbage of a more valuable description [205]. The utility of lime to turnips is so great, that though in the same field where no lime had been applied, the crop died away; yet in the limed part, the turnips flourished with unabated vigour [206]. On the Mendip lands in Somerset, by the application of lime, the value of land was raised from 4s. to 30s. per acre; and dung, which, previous to liming, had no sensible effect, operated, after its application, as on other lands [207]. Macclesfield Forest, in Cheshire, and vast tracts in the northern and more elevated parts of Derbyshire, and the adjacent districts, have been astonishingly improved by the same means [208]. The rye lands of Herefordshire, in 1636, refused to produce wheat, pease, or vetches; but since the introduction of lime, they have been so fertilized, as to be successfully applied to the growth of every species of corn [209]. By the application of lime, a larger quantity of straw is produced, more dung is procured, and the crop is less liable to be lodged. Its utility in effecting the destruction of worms and other vermin in the ground, is well known. In newly cultivated soils of a tolerable quality, the richest manure will not enable them to bring any other crops than oats or rye, to maturity, whereas, if they receive a sufficient quantity of lime, crops of pease, barley, or wheat, may be raised with advantage [210]. The benefit resulting from the use of lime, has been indisputably proved in the same farm; for the richer parts that were left unlimed, were uniformly inferior in produce to the poorer that had been limed, during a period of not less than twenty-one years, under the same course of management [211].

2. *Disadvantages of Lime as a Manure.*—It must not be imagined however, that the application of lime, can always be made with profit. When either used in too great a quantity at once, or too frequently repeated, it renders a soil sterile. Hence the common remark, *that where it is carried farthest*, and, consequently, on an average of years used most sparingly, it does most good. It only operates advantageously, when it has a superabundance of vegetable matter to act upon; and, as will afterwards appear, when it is applied, not in a caustic, but in a mild state. On light soils, it is peculiarly hazardous to repeat it too often, except in compost [212].

3. *The Principles on which Lime operates as a Manure.*—Lime has no enriching qualities in itself that can promote vegetation; but it chiefly operates, by reducing the inert ve-

getable matter in the soil, so as to become the food of growing plants; and is of use as an exciting manure, rendering the soil more prolific, by giving a new stimulus to enriching manures. It also acts, by improving the mechanical arrangement of the soil. It tends to bind and consolidate a soil that is too light and loose, and attracts moisture to it from the atmosphere; and it opens the pores of a clay or adhesive soil, and reduces its tenacity. Wherever vegetable matter abounds, either in the state of herbage or sward, or in a more decayed state in the soil, lime, if judiciously applied, in a dry and powdery form, will bring it into action, to the powerful support of growing plants. But where little vegetable matter prevails, or where it has been already much reduced by previous liming, farther applications of that substance can do no good, but may be injurious. Lime, whether applied when hot and powdery, or when it has again absorbed carbonic acid, and become more damp and solid, has great lasting effects on the mechanical arrangement of the soil. The action of lime, in reducing vegetable matter to operate as food for plants, is speedy and powerful; whereas, in opening the pores of clay, it acts slower, but more permanently. One of its principal advantages is, that by its agency, *iron pyrites*, a combination of iron and sulphur, very common in some soils, and very hostile to vegetation, is decomposed.

4. *The various sorts of Limestone.*—Sometimes limestone is almost perfectly pure, as is the case with marble, which frequently contains scarcely any other substance than carbonate of lime. Several sorts of limestone however, have mixtures of clay and sand, in various proportions, by which the efficacy of the manure, in proportion to the quantity of these substances, is considerably diminished. It is necessary, therefore, to analyze limestone, to ascertain the proportion of pure lime, before it becomes advisable to use so expensive an article in great quantities, more especially if it must be conveyed from a distance ([213]). Bituminous limestone makes good manure. But the magnesian is the species which requires the greatest attention, for though it usually contains only from 20.3 to 23.5 of magnesia, yet, Mr Tennant found, that the proportion of that substance, sometimes reached even 40 per cent. From the peculiar qualities of that lime however, it would in general be injurious, to apply more than from 25 to 30 bushels per statute acre, though, in very rich soils, that quantity may be increased, and still more with peat, on which its application in abundance, would have a most powerful effect in producing fertility ([214]).

5. *Mode of preparing it for Use.*—Limestone is burnt in kilns of various constructions, and with various sorts of fuel, as coal, peat ([215]), furze, or faggots. It is applied with advantage, in a caustic state, to soils recently reclaimed; but is generally *slaked*, by throwing water upon the lumps, until they crack and swell, and fall down into a fine powder ([216]). This operation, when it is to be done, should not be delayed, for, if properly calcined, limestone is easily reduced to powder, which may not be the case, if the slaking be postponed. If water cannot easily be obtained, the lumps may be divided into small heaps, and either covered with earth, by the moisture of which they are soon pulverized; or they may be made into large heaps, the lumps and earth in alternate strata, the former four inches, the latter six inches thick, and the whole covered with earth. Where it can easily be had, it is a great advantage, to slake the calcined limestone for manure, with the sea-water ([217]).

6. *Application.*—Summer is the proper season for applying lime, for the land ought not only to be dry, but the surface as free from moisture as possible, so as to promote the equal distribution of the manure. That experienced farmer, Mr Rennie of Phantassie, was of opinion, that the most profitable period for applying lime is, when the land is under summer fallow, in the months of June and July, that it may be completely mixed with the soil before the crop is sown, and when the soil is thoroughly pulverized. It was a favourite maxim with the celebrated George Culley, "that the land should be in a "powder, and the lime in a powder also." For a turnip crop, lime should be laid on in the spring, or early in summer, that it may be thoroughly incorporated with the soil, by the ploughings and harrowings it will receive before the turnips are drilled ([218]). The land will thus have time to cool, and the lime will not dry up the moisture necessary for bringing the turnips into leaf, or destroy the young plants. If it cannot be done earlier, when the turnips are nearly fit for the second hoeing, lime should be worked into the land by means of scufflers, or small ploughs passing between the rows; for it has been observed, that with the aid of lime, turnips maintain their growth to a later period in the autumn, and preserve a fresher leaf throughout the winter, than otherwise they would do. When lime is applied to old ley, it is a good practice, to spread it on the surface, previously to the land being broken up, by which it is fixed firmly on the sward. The application of lime in this manner, one year before ploughing, has been found of use; but when applied three years before, greater

advantages have been produced. In the former case, the increase of oats was only at the rate of 6 to 1, but in the latter, at that of 10 to 1, of the seed sown [219]. The quantity applied must vary according to the soil. From 240 to 300 bushels of unslaked lime per acre, may be applied on strong lands, with advantage. Even 600 bushels have been laid on at once on strong clays, with great success [220]. On light soils, a much smaller quantity will answer, say from 150 to 200 bushels, but these small doses ought to be more frequently repeated. When lime is applied to heavy clay, in order to open its pores, too much can scarcely be laid on; but when applied to bogs, moorland, or moss, the quantity for the first dressing, need not exceed what is usually given to other land. After the moss has acquired a sward of green herbage, lime is the proper manure; but unless it be applied in moderate quantities, the crop of grass will become so strong, as to lodge before it is fit for cutting. The real quantity however, of calcareous matter to be used, depends upon the quality of the limestone. It often happens, that five chaldrons do not furnish more *effective manure* than three, because they do not contain three-fifths of calcareous matter [221].

7. *The Expense.*—So great is the variety, in regard to the prices of lime at the kiln;—the cost attending its conveyance to the field;—and that of slaking, carting, and spreading it there;—and above all, in respect of the quantities necessary for different soils, in different circumstances, that no accurate statement can be given of the expense of liming. On the whole, for unslaked lime, about 6*d.* per bushel may be stated as an average price, all charges included; and from 120 to 300 bushels, as the quantity required, per statute acre. The following table will then furnish some general idea of the probable expense:

Table of the Expense of Liming.

Quantity of Bushels of unslaked Lime.	Expense of the Lime per Bushel.	Total Expense per Statute Acre. L. s. d.
120	6*d.*	3 0 0
150	Ditto.	3 15 0
200	Ditto.	5 0 0
250	Ditto.	6 5 0
300	Ditto.	7 10 0

8. *Effects of Lime.*—It is evident from the preceding table, that many farmers must subject themselves to an expense of not less than ten shillings per acre per annum, for the lime which they use, during the course of a rotation; and yet they are amply remunerated. The benefit derived in the cultivation of green crops, is sufficient for that purpose. Good crops may be raised by large quantities of dung; but where calcareous substances are applied, it is proved by long experience, that a less quantity of animal and vegetable manure will answer the purpose. This is making the farm-yard dung go farther, with more powerful, and more permanent effects; for in consequence of the weightier crops thus raised, the quantity of manure on a farm will be most materially augmented. Indeed upon land in a proper state for calcareous application, (as old ley, where it has abundance of vegetable matter to act upon), lime is much superior to dung. Its effects continue for a longer period, while the crops produced, are of superior quality, and less susceptible of injury from the excesses of drought and moisture. The ground likewise, more especially if it be of a strong nature, is much more easily wrought; and, in some instances, *the saving of labour alone*, would be sufficient to induce a farmer to lime his land, were no greater benefit derived from the application, than the opportunity thereby gained, of working it more easily, and in a more perfect manner ([222]).

9. *Rules for the Management of Lime.*—1. It is necessary to ascertain the quality of the soil, and also, whether it has formerly been limed, and to what extent, before any lime is applied. It may in general be observed, that strong loams and stubborn clays, require a full dose of lime to bring them into action, as such soils are capable of absorbing a great quantity of calcareous matter. Lighter soils however, require less lime to stimulate them; and may be injured, by administering such a quantity, recently calcined, as would prove moderately beneficial to those of a heavy nature. 2. As the effects of lime greatly depend on its intimate admixture with the soil, it is expedient, to have it in a powdered state before it is spread, and the drier, and the more perfectly powdered, the better. 3. Lime having a tendency to sink in the soil, in consequence of having its weight increased by the water which it imbibes, it cannot be ploughed in with too shallow a furrow, or kept too near the surface. 4. Lime ought not to be applied a second time, to weak or poor soils, except at a considerable distance of time, or unless mixed with earth in compost. After a second application, the

land should be immediately laid down to grass. In many soils, more especially when newly cultivated, calcareous earths will, in the course of years, so far disappear, as to require a renewal. This sooner or later takes place in all cases, but more rapidly in pastures than in arable land, the plough often bringing up the lime to the surface.

10. *Difference between Caustic and Mild Lime.*—This is a point that has not hitherto been sufficiently attended to, and yet, unless it is well understood, lime may often be misapplied. The following hints, extracted from a paper written by an intelligent agriculturist ([223]), will throw some light on this important inquiry.

Lime, when newly burnt, is of a caustic nature, and often retains that quality *longer than is commonly imagined.* If applied to dead, but undecayed vegetables, it shrivels them up, and destroys their organization; it may be used, therefore, with great advantage, for the destruction of weeds in fallows. It may be advantageously employed in all cases where there is a great abundance of vegetable matter; but where the soil is deficient in nutritious substances, mild lime ought to be preferred. Caustic lime is said to *exhaust* the land, because it hastens the putrefaction of the animal and vegetable matter in the soil, and thus a larger portion of them is applied to the growth of plants, in a given space of time, than would otherwise have been the case. In this manner, it first produces more luxuriant crops, and in the next place, it enables the farmer to continue his land in tillage, until it is more completely deprived of the principles of fertility, than could have been practicable, if the calcareous manure had not been used. Caustic lime is of so burning a quality, that the dung of horses, dropped round a lime-kiln, is so completely destroyed, either by that which falls from the carts in filling, or the particles blown about by the wind, as to become absolutely useless. It is not fit, therefore, to be employed with dung when in that state. If quick-lime is used with a crop of potatoes, the sets are corroded by it, and the crop rendered curled and scabbed. When lime, in a caustic state, is applied to land, it is of service by destroying acidity; but it exhausts the soil of the carbonic acid, or fixed air, which it contains. It is of great use in composts, (as shall be afterwards explained); but dung should not be mixed *with caustic lime*, nor with animal manures, unless they are too rich, or to prevent any noxious effluvia, as in the case of night soil.

Mild lime, on the other hand, may often be applied with advantage, when caustic lime would be injurious; and more especially to lands exhausted by injudicious cropping, or weak, from a deficiency of manure.

In the neighbourhood of Grantham, the farmers desisted from the use of lime, because they found their lands had been exhausted by it; but the limestone being employed to repair the roads in the neighbourhood, the scrapings, which consisted of mild lime, were, with great advantage, applied to the same lands. Lime made of chalk, has often been condemned as exhausting; yet the same chalk, uncalcined, has been found beneficial. In Dumfriesshire, where mild or *effete* lime is used for potatoes, it makes the crop more productive, and greatly assists the dung; and where mild lime is used in compost, it is supposed that a portion of dung may, without loss, be mixed with the heap. The pounded shells of oysters have lately been applied, as a manure, with much success (224).

In order to render caustic lime perfectly mild, it is sometimes necessary to turn it over frequently, so as to have it completely saturated with fixed air, or carbonic acid, before it is applied (225).

2. *Pounded Limestone.*—This substance differs from calcined lime, in containing fixed air, or carbonic acid, and likewise as being insoluble in water. Machines for pounding limestone, were erected in Scotland many years ago, but unfortunately, were destroyed before the experiment had been fairly tried. There is evidence, that the attempt was attended with success so far as the experiment had gone (226). The practice might certainly be of use in districts where fuel is scarce. The scrapings or dust of roads made with limestone, (which are in fact pounded limestone), have been employed with advantage as a manure, in Yorkshire, Gloucestershire, and other districts, and ought never to be neglected. The dust of marble, and the splinters of limestone quarries, are also of use.

3. *Limestone Gravel.*—This excellent manure, (by some called *corn* gravel, from its productive qualities in arable soils), is peculiarly calculated for peat-bogs, the weight of the article, giving a pressure that is much wanted. It has likewise been tried on sandy soils with success, when mixed with substances of a gluey or adhesive nature (227). Kirwan considers this substance to be a species of marl, mixed with large lumps of limestone. Its effects are equal in fertility, and more permanent than lime. It has been of immense benefit to Ireland, and may probably be found in many other parts of the United Kingdom, if diligently searched for. Its value was accidentally discovered in a parish in Scotland, where it has since been used with the greatest success (228).

4. *Chalk.*—This calcareous substance, proves a useful manure in many of the southern and eastern districts of England, where it abounds. It is frequently applied in a crude state, spread upon the surface in autumn, and left to be dissolved by the winter's frost. From five to eight waggon loads per acre, are attended with beneficial effects, the benefit of which is felt for fifteen and even twenty years. When calcined, from 100 to 200 bushels per acre are applied, but the effects not being lasting, the application requires to be repeated every four or five years; and as *chalk lime*, does not exceed in any material degree chalk itself, there is no encouragement to burning it, more especially as *calcined limestone*, where it can be obtained, is much more effectual. Both chalk and marl are supposed to have the beneficial effects of all the calcareous earths, in giving stiffness and whiteness to straw ([229]), as well as rendering the skin of corn thin, and increasing the quantity of its meal ([230]). Chalk has a great effect in making land work more kindly. It answers well with strong clays, rendering them drier, by which they are enabled to be ploughed more early, and to work mellower.

5. *Marl.*—Of this substance there are four sorts,—Rock,—Slate,—Clay,—and Shell marl. The three former are of so heavy a nature, as to be seldom conveyed to any distance; though useful, when found below a lighter soil, to which they can be applied without incurring much expense.

As in Lancashire and Cheshire, clay marl is the great source of fertilization, and neither labour nor expense prevents the most vigorous application of it; it may therefore be proper, to give a general view of the mode of using it adopted in those districts.

The first object is, the disposition of the pits. These are made where the least land is thereby destroyed;—where they afford the least strength of carriage;—where they require the least draught;—where they will occasion the least damage to the lands in future;—and where, if that point can be obtained, it is practicable to lay them dry, when no longer necessary ([231]).

The pits are worked by undermining, and loosening on each side large masses, and then by driving long piles in at the top, sometimes with the aid of water, so as to force the mass down. This method is expeditious, but attended with danger to the workmen.

Marl is generally laid on grass lands, the operation being begun in May or June, and carried on during the summer; the older the sward the better. The union of the marl and grass, causes a fermentation and putrefaction, which seem necessary to produce a full effect.

The quantity of clay or red marl used, is enormous, in many cases about 300 middling cart-loads per acre; and the fields are sometimes so thickly covered, as to have the appearance of a red-soiled fallow, fresh ploughed. In some cases, slighter coverings are preferred, and the process is more frequently repeated. It is proper however to remark, that much injury has been sustained, from over-dressing with clay and marl, without making at the same time, an adequate application of rotten turf, sheep droppings, farm-yard manure, or some other enriching stimulant. The application of clay and marl, should always be regulated by the quantity of manure that can be spared. A heavy coat of cold clay, or marl, without dung, upon land poverty-struck by injudicious tillage, is so extremely injurious, that it cannot be too loudly reprobated.

Marl, after carting, is left on the ground in a rough lumpy form, that it may be exposed as much as possible to the influence of the weather. It should partake of one summer's sun, and of one winter's frost, by which it is reduced into the form of an unctuous, but friable material, the further dispersion of which, is easily effected, by clodding beetles, or mallets, spades and harrows. It is thus equally distributed over every part of the surface, and afterwards ploughed in; and the effects are represented to be in the highest degree beneficial ([232]).

In regard to shell-marl, it consists chiefly of calcareous matter, the broken, and partially decayed shells of fresh-water animals, found at the bottom of lakes and ponds, often covered with mud. It may be applied as a top-dressing to wheat and other crops, when it would be hazardous to use quick-lime. In the counties of Selkirk, Forfar, Ross, Caithness, and in other districts, shell-marl has been of great value in fertilizing the soil, though, from its stimulating powers, the land has been often injured, by employing it in too great quantities, and afterwards injudiciously over-cropping.

6. *Sea Shells.*—This manure abounds in various parts of the British Isles. When pure, it is superior to the usual sorts of limestone, in respect to its proportion of calcareous matter. It likewise often contains a small portion of animal substances. These shells have not, however, unless when burnt, the same rapid and powerful influence on the soil. When not burnt, they are much improved in their effects, if broken by a mill resembling that used for tanners' bark, to give the air a readier access to promote their decomposition, and to enable them to

be more equally distributed. Where straw is scarce, they are used as a substitute for litter; and the urine greatly contributes to the decomposition of the shells.

Sea-sand, with a mixture of shells, is used with much success as a manure, on the coasts of the North and East Riding of Yorkshire ([233]); in Devonshire, and Cornwall ([234]), in Caithness, and on the coast of Buchan in Aberdeenshire. It is particularly useful in strong clays, as both its component parts, (sand and shells), are beneficial mixtures in a clay soil.

7. *Coral.*—This substance is greatly superior to common shells, as a manure. On the coasts of Devonshire and Cornwall, it is found mixed with the common shelly sand ([235]); but in some of the Western Islands of Scotland, it exists in considerable quantities, almost unmixed, and has frequently been tried with great success. In the parish of Southend, in Argyleshire, there is a bank of fine coral, about 100 yards from the sea-mark. It is considered to be superior to lime for moist heavy lands. To gardens it is of signal service, and it likewise improves pasture and heath lands ([236]).

8. *Soapers' Waste.*—This is considered to be a useful manure of a calcareous nature, with a proportion of other substances mixed with it. It is best calculated for grass lands, to the beneficial effects on which the gypsum, and saline substances which it contains, must necessarily contribute. It is likewise of use to peaty soils, and is excellent for gardens, from its destructive effects on insects. The average quantity applied, is about 100 bushels per statute acre, but greater quantities have been used with success. It is advantageously employed in compost. Autumn is the best season for applying this manure to grass lands. For arable lands, the quantity should be greater than for grass lands, and greater on strong soils, and on peat, than upon light loams, and least of all, on dry soils and gravels ([237]). It is too weighty a substance to be carried to any distance.

9. *Gypsum, or Plaster of Paris.*—This manure was discovered by Mr Mayer, a German clergyman of uncommon merit, in 1768, and it has since been applied, with signal success, in Germany, Switzerland, France and America. If in England it has not been so much approved of, it must be owing to the circumstance, that the calcareous principle there almost universally prevails. Gypsum consists of sulphuric acid and lime, and its application to crops of cultivated grasses, in such moderate quantities as five or six bushels per acre, is often attended with great effects. The ashes of sainfoin, clover, and lucerne, when these plants are calcined, afford

that substance in considerable quantities; and hence there is reason to believe, that it is a necessary part of the woody fibre of these, as well as a component part in most of the other grasses. Cultivated soils in general, contain it in sufficient quantities for the grasses which they produce; but where there is any deficiency, fields, which have ceased to bear good crops of clover, and other artificial grasses, are often completely restored to their former fertility, by the use of gypsum ([238]). It imparts such a vigour of vegetation to plants, destined to form either natural or artificial pasture, that it stimulates them constantly to push forth very succulent shoots, and frequently to renew the stalks which are cut for cattle. The *rationale* of its effects may be deduced from its extraordinary septic quality, for it is found to accelerate putrefaction in a greater degree than any other substance; and hence, it is not ploughed in like other manures, but barely strewed on the surface of the land of a dry quality, such as suits clover.

In lands full of calcareous matter, the celebrated Ingenhouz strongly recommended, sprinkling sulphuric acid on the soil, so as to make an *artificial gypsum.* This, he contended, would be a likely means of benefiting the crops of clover, and other valuable grasses, and might be useful even to crops of corn. The plan is well worth a trial, in soils where calcareous earths much abound. There is reason also to hope, that the application of sulphuric acid may be of use, both to tilly and to mossy soils, by neutralizing any noxious substances they may contain, unfavourable to vegetation.

3. *Earthy Manures.*

Under this head may be classed, vegetable mould or loam, peat-earth, clay or sand, burnt clay, sea-ooze or warp, canal, pond, or river mud, and road-scrapings.

1. *Mould* or *Loam.*—In many cases, as in forming roads, making canals, erecting new houses, &c. considerable quantities of excellent mould or loam are dug up, which, not being required for any purpose on the spot, are removed, and applied, either in making compost dunghills, or in augmenting the staple of land, where there is any deficiency of depth.

2. *Peat Earth.*—This substance, (called *bog-stuff* in Ireland), when applied to light and gravelly soils, produces excellent crops, more especially if mixed with a small portion

of lime or clay ([239]). It may likewise be of use in opening the pores of an adhesive clay soil; but it cannot unmixed be considered as an enriching manure, though it may be advantageously employed in composts. It has been remarked, that no plants grow on the refuse of a peat-stack or heap, which could not be the case, if that species of earth, by itself, were favourable to vegetation.

3. *Clay*, or *Sand*.—The plan of improving the texture of a soil, by conveying clay, where sand predominates, and the reverse, has been already alluded to, in Chap. I. Sect. 2, and has been attended with great advantage. Clay can hardly fail to be useful to sand; but it has been justly observed, that many soils acquire the name of clays, because they are cohesive for want of effective draining, which, when examined, are found to be *sandy loams*, and consequently have no occasion for any additional quantity of sand ([340]). In Cheshire, sand is frequently used as manure on stiff lands, and when laid on in sufficient quantities, with great success ([241]).

4. *Burnt Clay*.—It is well known, that burning clay is an old practice, which, at various periods, has been pursued with energy, and at other times has fallen into neglect. In a work printed in London, an. 1732, "*The Country Gentleman's Companion*," it is stated, that the Earl of Halifax was the inventor of that useful mode of improvement; and that it was much practised in Sussex. There are, in that work, engravings of two kilns for burning clay, one adopted in England, and the other in Scotland, where it is said to have been ascertained, that lands, reduced by tillage to poverty, would produce an excellent crop of *turnips*, if the ground were ploughed two or three times, and clay ashes spread over it. In 1786, Mr James Arbuthnot, of Peterhead, revived the practice, and tried several successful experiments with burning clay, with a view, both to simplify the process, and to reduce the expense; but it has never been very extensively adopted ([242]). An intelligent correspondent, however, maintains, that burnt clay deserves to be ranked among the most valuable manures, not only from the facility with which it is obtained, but from its being suited to soils in general, and to crops of every description ([243]). This is accounted for, by its containing oxide of iron, which is favourable to vegetation. It is said, that more than one half of the potatoes raised in Ireland, more especially in the western parts of that country, are produced from that manure ([244]).

In preparing clay for manure, a great distinction ought to be made, between burning it into ashes, and merely torrefying it. When thoroughly burnt, the whole texture of the soil is destroyed, and clay is reduced into a species of *dried earth*, divested of all soluble matter, and which can only act mechanically on the soil. But when clay is merely torrefied, or scorched, the staple of the soil is but little reduced; and as it is during that process, that the clay acquires fertilizing properties, it is evident, that the more slowly it is carried on, the better will be the manure produced.

5. *Sea-ooze*, or *Warp*.—This substance abounds at the mouths of friths, estuaries or arms of the sea, and of the rivers which run into them. It is of a most enriching nature, and adds to the staple of the soil. It is used as a top-dressing in spring, for crops both of grain and grass, more especially for the latter. It is an excellent material for composts, particularly for thin soils. The late public-spirited Duke of Bridgewater, between the years 1790 and 1800, made considerable use of sea-ooze, brought up from the Mersey, in barges, by his canal, to lands near Worsley. It promotes the improvement of garden soils in a manner hardly to be credited; and wheat or oats, manured with sea-ooze, are little subject to rust, mildew, or any other disorder ([245]).

6. *Canal, Pond, or River Mud*.—This article is not of equal use in every instance, as much of its quality depends upon the substances with which it is mixed. Where the water is resorted to by cattle, or water-fowl, or receives the washings of towns, houses, farm-yards, &c. or the immediate drainage of large tracts ([246]), it is richer, and will prove valuable, in whatever way it is managed ([247]). It must at any rate add to the staple of the soil with which it is mixed, and bring with it some useful ingredients. In the Netherlands, it is found by the gardeners of Ghent, that the mud of canals and rivers is much improved in its quality, when it is exposed, in small heaps, to a winter's frost, and a summer's sun, before it is used. This proves how much the success of agriculture depends upon *minutiæ*. For the same substance, which, if mixed with the soil, immediately after being taken up, might be of little or no use, may, when properly prepared, be highly conducive to fertility.

7. *Road Scrapings*.—The mud raked and shovelled from the public roads, may, with great advantage, be used as an ingredient for forming composts, particularly for clay soils. Where the stones of which the roads were made, consist of limestone, such a compost is singularly useful. In particular instances it is even more economical, to purchase road scrap-

ings than town dung, on account of the carriage (248). Indeed the dust of limestone roads, if collected, and kept dry until spread on the land, would answer as well, if not perhaps better, than mere lime, owing to the dung of horses, &c. being mixed with it (249).

4. *Vegetable Manures.*

Manures from the vegetable kingdom, comprehend the following articles: Sea-weeds;—Fresh-water weeds;—Common weeds;—Malt-dust;—Rape-cake;—Tanners' bark;—Vegetables ploughed in;—Vegetables that have passed through fire;—and, Dry vegetable substances.

1. *Sea-weeds.*—In many districts, these are a most important source of fertility, and when used with judgment, never fail to enrich the coast lands of every district where they can be had, whether cut from the rocks, or thrown ashore. Their effects, however, are by no means so lasting as those of farm-yard dung, enduring only for one or two crops.

Sea-weed, when applied to arable land, ought to be spread and ploughed as soon as possible after it is secured. If that cannot be accomplished, from the season of the year or otherwise, it should never be laid up in heaps to ferment, but should be made into a compost with earth, with long dung, and with a moderate quantity of lime (250). Tangle, or drifted sea-ware, if spread on old grazing pastures, not only improves the quantity, but the quality of the herbage; hence both cattle and sheep eat it with avidity, thrive well, and are made sooner fat. It is not so well calculated as dung for oats, or for a crop of turnips; but it answers peculiarly well for barley. If applied to the tender blades of young clovers after harvest, it will destroy the plant (251). It may be advantageously mixed with farm-yard dung, for the purpose of rotting the dry parts of its contents. When separately applied, it requires one-third more by weight per acre, than farm-yard dung.

Sea-ware has several advantages above other sorts of manure. It is not filled with seeds of weeds;—it readily decomposes;—does not require a long process of preparation; and is directly useful to the plants. With its aid, the farmer is enabled to take more frequently crops of grain, or green fallow crops, and thus increases his farm-yard manure. Its good effects cannot be disputed, and nothing can be objected to its use, but an idea, that the grain which it produces is of a smaller size, or of inferior quality.

It is of such importance to the farmers, to have ready access to sea-weeds, that lands in East Lothian, formerly let at from 10*s.* to 15*s.* per acre, are now rented at from L. 2, 10*s.* to 3 guineas per acre, and upwards, in consequence of having a command of that manure.

2. *Fresh-water Weeds.*—These substances are frequently found in lakes, ponds, and rivers; and being replete with vegetable nutriment, merit the particular attention of those who have such useful articles at their command. They may be carried into the farm-yard to increase the heap; or made into a compost with earth; or ploughed into the ground for barley; or used in drills for turnips; or reduced into a nutritive mass, by a mixture with hot lime. In Flanders, fresh-water weeds are accounted the best possible manure for potatoes, as so large a proportion of that root consists of liquid matter; and on the same ground, sea-weeds must be of use in the culture of that plant.

3. *Common Weeds.*—It has been found, that an excellent compost can be prepared, by collecting all sorts of weeds, as thistles, docks, nettles, fern, &c. before they have formed seed, and instead of burning them, laying them up, in alternate layers of rich earth, so that they may be subjected to the putrefactive process. A great heat is soon raised, and by turning the heap over next spring, the whole will be resolved into a soft pulpy mass, the effects of which on the soil, are in no degree inferior to dung. Thus a great nuisance may be converted into a valuable manure ([252]). Where lime is abundant, it should be mixed in its caustic state, with green or succulent weeds; and as the moisture which they contain will slake the lime, a considerable degree of heat will be created, by which the weeds will be speedily reduced ([253]). When the weeds are in a dry and withered state, they are not so easily formed into a putrescent mass.

4. *Malt Dust.*—In some districts, this substance is employed, as a valuable article for feeding milch cows, or pigs; in others, it is used as a manure, and found to be highly fertilizing. From 40 to 60 bushels are applied to an acre, either for wheat or barley. It likewise greatly improves cold grassland ([254]).

5. *Rape-Cake.*—This species of manure, has long been used in various parts of England, particularly in Yorkshire and Norfolk; and its copious use, has been one of the most efficient means by which, under the auspices of Mr Coke,

the agriculture of the latter county has been improved. It is applied in various proportions, from one-half to one-sixth of a ton per statute acre, the quantity being regulated by the quality and condition of the land,—by the nature of the crop,—and by the means of the farmer. Mr Curwen ascertained, that five hundred weight of rape-cake, mixed with two tons of dung, will manure an acre for turnips ([255]).

It has been found in Flanders, that powdered rape-cake, strewed over the surface of the ground, destroys the *gryllus talpa*, so injurious in wet-soils; and every insect of the same species, may be destroyed by the same means.

Such is the quantity of this manure used in the Netherlands, that a farmer, who only cultivates 75 English acres, purchases at the rate of 5000 rape-cakes, and 3300 cakes from poppy-seed, for manure, which cost him nearly L. 60 per annum ([256]).

The quality of the dung produced in a straw yard, is wonderfully enriched, by giving the cattle a portion of oil cake. A farmer in Cambridgeshire actually gave his cattle cake, for that purpose alone, when he knew that the price of beef would yield him no remuneration for it; and so convinced are the farmers upon the light soils in Surrey, of its efficacy, that they have been known to give a field of turnips to a sheep jobber, upon the sole condition, that the sheep were to have a certain quantity of cake, to be eaten upon the field, along with the turnips.

7. *Tanners' Bark.*—Mere woody fibre, like tanners' bark, requires fermentation to render it nutritive to plants ([257]). It is sometimes mixed with lime, but a compost with dung, is more likely to be useful in rendering this substance fertilizing; or it may be mixed with a clayey soil, to render it more tender and friable. It will not bear a distant conveyance.

8. *Vegetables ploughed in.*—The propriety of this system is much disputed. It was practised by the ancients, and is still said to answer well in warm climates; and in the warm seasons of cold climates. Several successful experiments with ploughing in vetches, the tops of turnips, and the stalks of potatoes, have been detailed by an intelligent agriculturist in Ireland ([258]). But after being tried for several years in Lincolnshire, with buck-wheat, it was ultimately given up as doing no good ([259]); and the general opinion is, that more benefit is derived from green crops, when consumed by stock, and converted into dung, than when ploughed in, without any mixture of that animal mat-

ter with which dung is necessarily impregnated [260]. *The profit derived from feeding the live stock, on the green food, ought likewise to be considered.*

9. *Burnt Vegetables.*—These are of various sorts, as wood-ashes,—peat-ashes,—kelp, or the ashes of sea-weed,—and burnt straw.

Wood-ashes are certainly a valuable manure, and are peculiarly well calculated for gravelly soils and loams. The proper quantity to apply, is forty bushels per acre, and spring is the proper season for the application. If rain succeeds, the effect may be relied on [261].

The ashes of peat are a common manure, wherever that substance is used as fuel; but they are frequently of little value. There are two sorts of peat, however, one to be found in its greatest perfection, near Newbury in Berkshire, and the other in some provinces in Holland, the application of which is attended with astonishing results.

In some soils, particularly chalk, the Berkshire ashes may be of use, by supplying the oxide of iron, an article without which no soil can be productive, and of which chalky soils are extremely deficient. In others, the gypsum or potash which such ashes contain, may promote fertility.

In Holland, they have two kinds of peat. One which is found on rising grounds, burns quickly and cheerfully, gives a good heat, and leaves only light ashes of very little value. The other sort is found in marshes, which are constantly covered during the winter season, with water of a *brackish* nature. This peat leaves a much heavier ash, frequently so full of saline matter, that it is sometimes used as a substitute for soda, in the manufacture of green glass. These ashes are conveyed by the canals, in barges, into the interior of Flanders; and after they have reached Brussels, they are sent by land, from 50 even to 100 miles into the interior. The effect of these ashes is hardly to be credited. They are sown upon young clover in spring, and insure two good crops of clover that year, and an abundant crop of wheat, unmolested by the wire-worm, next year. If it be the wish of the farmer to have clover for two years in succession, it may be obtained by the aid of these ashes. They are in general carefully sown by the hand, like grain, in a still, hazy morning. They are good for hops; and a handful should be spread on the surface of each hill, on which the hop vines are planted, to destroy the worms that infest them [262]. In various parts of England, Scotland, and Ireland, peat, producing similar ashes, may be met with; but experiments on a great scale, with the real Dutch ashes, ought first to be tried, to ascertain their efficacy in this country. They are now subject to a very heavy duty, which ought certainly to be taken off.

Peat-ashes, burnt in the Berkshire mode, are an excellent manure for turnips. If as many ashes are strewed, in the furrow of a drill, as are sufficient to cover the surface, the crop will be abundant; and if the turnips are afterwards eaten off by the sheep, the land, in the opinion of some, will be as much enriched, as if the turnips were produced by farm-yard manure.

Kelp, or the ashes of sea-weeds, has of late been strongly recommended as a useful manure, and the experiments which have been tried, have, on the whole, been successful. Immense quantities of this substance might be obtained, from the western and northern islands of Scotland, and from various parts, both of England and of Ireland. Indeed the supply is almost inexhaustible; the manufacturing of it would employ a number of labourers in all those places where these weeds are found, and would insure their comfortable subsistence ([263]).

The ashes of coleseed straw, or haulm, and of common straw, or stubble, have been made use of for turnips and other crops, with success. Indeed it is now ascertained, that the burning of straw, stubble, or any other combustible material on the surface of the ground, after it is prepared for turnips, but before the seed is sown, is the most effectual mode hitherto suggested, of destroying the fly, and preserving the crop from their attacks. In France, more especially near Angers, and in Brittany, bushes are burnt, with advantage to the succeeding crop ([264]).

10. *Dry Vegetable Substances.*—It has been found in Dumfriesshire, that the husks or shells of oats, form an excellent manure; fresh vegetable matter, as saw-dust, when simply reduced by mechanical division, is of use by itself; but is much improved, by a mixture with other substances, as the refuse of butchers' markets, urine, &c.

5. *Miscellaneous Articles of Manure.*

This head contains, Salt;—Soot;—Refuse of various manufactures;—Refuse of coal-mines;—And the refuse of lime-kilns applied as a top-dressing to grass lands.

1. *Salt.*—The utility of salt as a manure, and for other agricultural purposes, is a subject of such importance and extent, that it requires a separate discussion. (See the Addenda, No. 4). There are three particulars, however, connected with the subject of salt as a manure, which it may be proper here to mention.

1. In a series of experiments tried by the Rev. Dr Cartwright, he found a mixture of salt and soot, *in moderate quantities*, as a top-dressing, preferable to any other sort of manure [265], a circumstance which might be attended with considerable advantages to farmers in the vicinity of large towns.

2. It has been ascertained in America, and confirmed by experiments in this country, that salt is an excellent manure for flax. The quantity of salt should be double that of the seed used, and should be sown at the same time. It is probable, that all oily seeds should be treated in the same manner.

3. But the most important circumstance, respecting the beneficial effects of salt, when employed as a manure, is the probability that it will prevent the rust in wheat. That might justly be pronounced, the greatest agricultural discovery of modern times, if it were found in all cases effectual.

2. *Soot.*—This is an excellent manure, but it can only be procured in large quantities, in the neighbourhood of great towns. It contains substances highly favourable to vegetation; for the effects of soot, when spread upon the surface, are discovered immediately after the first rain. It is likewise of use, from the saline matter which it contains, in promoting the destruction of slugs. When applied in its natural state, as a top-dressing for clover, or young wheat, about twenty bushels per acre is the usual quantity; but it is frequently mixed with other articles. The most approved composition is, one part soot, five parts earth, and one part lime [266]. The earth and soot should be well mixed before the lime is applied. It should remain in that state five or six weeks, then be turned over again, and thoroughly incorporated, before it is sown on the ground [267].

3. *Refuse of Manufactures.*—Much excellent manure is collected at various manufactories, where mineral acids are not used. Soap-suds, lees and other impurities, which are taken from the boilers, should be mixed with ashes, straw, turf, peat, or any other substance that would absorb the moisture. Thus, what tends to render the water of streams

or rivers, into which these articles are at present too frequently thrown, impure and unwholesome, would enrich the land (268).

4. *Refuse of Coal-Mines.*—In the neighbourhood of coal-mines, much advantage might be derived from their refuse, which, at present, is not only lost, but is actually an encumbrance, covering much ground that might be rendered fertile. In many cases, these hills of coal rubbish ought to be reduced to ashes, which might be applied to grass lands with infinite advantage. Some kinds of schistus, shale, or blaes, mixed with slaked lime, in the proportion of one-third, have been found an excellent manure for wheat and other crops (269).

5. *Refuse of Lime-Kilns.*—Mr Monteath of Closeburn, in Dumfriesshire, places a grate at the bottom of his lime-kilns, (which is of great benefit, by increasing the draught of air through the kilns); and he thus acquires many hundred cart-loads of refuse, consisting of coal-ashes, mixed with small pieces of lime, which would have been of little value, had the ashes been mixed and measured with the large pieces of burnt lime. He has employed this refuse, mixed with earth, to great advantage, in top-dressing peat meadows, and grass lands of every description. In many districts, immense heaps of this refuse are left totally neglected, except by a few public-spirited individuals (270).

Nothing can be more desirable, than to bring into action, these sources of fertility, which are generally left unheeded. They not only produce immediate profit, but increase and improve the staple of the soil; and indirectly, are the means of augmenting those putrescent substances, so essential to vegetation.

6. *Composts.*

Every farmer of experience knows, that certain compounds formed of various kinds of manures and soils, have a much greater effect in promoting vegetation, than when applied separately. When the different soils and manures are analysed, we find, that some of them contain more animal, or vegetable matter, than they do of salts or earths, and *vice versa.* It is natural, therefore, to suppose, that advantage might be derived from mixing or combining the two kinds together.

Some farmers object to composts, on account of the expense, and affirm, that dung itself, is a much better manure, upon all soils, than it can possibly be made by any addition to it. But when earth is employed in the formation of a dunghill, it will absorb substances from the dung, which may otherwise be lost.

The subject of composts, may be considered under the following heads: 1. The materials used; 2. The soils or crops to which composts should be applied; and, 3. The effects produced.

1. *Materials.*—Unslaked lime, and earth of different sorts, are the substances commonly used. Quick-lime is the proper stimulus for bringing the powers of a compost into action; in some degree operating upon a heap of earth, as yeast does upon a quantity of flour or meal. Enough ought to be applied, to excite a species of fermentation in the heap, and to neutralize or decompose any pernicious mineral substances which may exist in it ([271]).

The preparation and conveyance of compost, being attended with much expense, where circumstances will admit of it, horse power ought to be employed in the several processes, instead of manual labour, and the compost should, if possible, be prepared in the field, to which it is afterwards to be applied.

It has been ascertained by a number of experiments, that two bushels of unslaked lime, are sufficient for each cubic yard of earth of a medium quality; and as 80 cubic yards of loose earth, are sufficient to manure an acre, 160 bushels of unslaked lime are commonly required, in an average of cases, to bring forward the process of fermentation. To obtain this quantity of earth, it is the practice of many farmers, to plough the head-ridges at both ends of the field, ten inches deep; and this can often be spared, without any loss, as these ridges are generally too high, in consequence of the earth accumulated in the course of years, from the plough being cleared every time it turns. This affords an easy mode of manuring a field with compost.

Composts are frequently made, not only of earth and lime, or dung, but of various other materials, as green vegetables, before they run to seed, soft chalk, tanners' bark, saw-dust, soap-ashes, &c. It is recommended, that instead of being laid in regular layers, they should be mixed as much as possible, in forming the heap. A fermentation is soon excited; *and the oftener the heap is turned*, so much the more will fermentation be promoted ([272]).

A mode of making compost, of which peat is the basis, was suggested by an ardent friend to agriculture, the late

Lord Meadowbank. It was not unusual, in various parts of Scotland, to bed cattle, and even sheep, with peat, for the purpose of increasing the quantity of manure; but Lord Meadowbank was the first individual in this country ([273]), who investigated the properties of that species of manure, and explained them on scientific principles. The result is, that one ton of dung, will ferment three tons of good peat, or moss earth ([274]). If either the dung or the moss be of inferior quality, it will only ferment two tons; but if, instead of dung, the refuse of whale blubber be mixed with good peat, a ton will ferment from four to five tons of peat moss. This is a most valuable discovery, and must, if duly attended to, greatly enrich many hitherto neglected districts. The great advantage of this compost is, that it has nothing but inert vegetable matter to act upon, whereas, when lime is mixed with rich earth, it may have the effect of dissipating the gaseous matters it contains, and of rendering it proportionably less valuable.

Besides mixing moss with dung, on the scientific plan pointed out by Lord Meadowbank, many farmers throw some moss-earth daily, into the floors of their stables and cow houses, and even into the bottoms of their dungstead, and the stanks near it, so that the moss-earth may absorb and retain the urine of the cattle, and juices of the dunghill; and the whole being thus brought into a state of fermentation, the antiseptic qualities of the moss, are thus overcome, and it is converted into a manure, nearly equal in quality to dung itself. By these means, many industrious farmers have added one-fourth, or one-third part to the value, as well as to the volume of their dung, every year. To get the full benefit of these operations, the moss earth should be thrown up, and exposed to frost, and afterwards dried a little, before being carried to the farm-stead; and if possible, it should be kept in a shade there, till used, so that its texture being reduced by frost, and half dried when laid on the stable floor, it may imbibe the urine more completely, and be converted by it to manure.

2. Composts are peculiarly well calculated for grass-lands. They are likewise of great use to moorish soils, augmenting their staple, and adding to them a number of valuable and enriching substances. In regard to sandy or clayey soils, composts, principally consisting of articles different from their general nature respectively, will improve their texture and convert them into loams.

3. The effect of composts is highly satisfactory. They

secure the fertilizing parts of the dung from the great loss occasioned by evaporation; and are useful in rendering various substances more safe and effectual in operating on the soil. In regard to grass lands, experience has shown, that they at once improve their quality, and check, for years, the progress of moss, or even unprofitable grasses ([275]). In thin moorish soils, composts, properly and repeatedly applied, alter the nature of the soil, by which it becomes more fertile, retains its moisture longer, and does not suffer by the summer's drought, as would otherwise happen ([276]). The effects of the Meadowbank compost are still more extraordinary, a farmer in Roxburghshire, (Mr Thomson, of Bewlie), having raised crops of turnips, and of wheat after fallow, on good soils, manured with this compost, as if it had been from dung ([277]).

It is a circumstance not to be omitted, that lime will operate in compost, upon lands that have been exhausted by the over frequent, or too abundant application of lime or marl, even where it had not succeeded when used by itself. This is a strong recommendation of mixing manures with earth, as land may thus be cultivated to advantage, that would otherwise remain unproductive.

On the whole, it may be safely asserted, that manure goes much farther in compost than in any other way. It is a safe and effectual mode of applying various substances to the soil. The mass becomes one uniform body, equally nutritious in every part. The gelatinous and mucilaginous substances are dissolved, and intimately mixed with each other, and when applied to the soil, become instantly the food of plants. There is little or no waste from evaporation, but rather a gain of nutriment from the atmosphere; and the quantity may easily be divided and appropriated, according to the size of the field to which it is to be applied, and the quantity which each part may require. It may be mixed with the soil, or applied to the surface;—it may be used at any time of the year, but its effects are more certain, when applied as a top-dressing, either early in autumn, or when vegetation commences in spring;—and it may be prepared at any time, whenever occasion requires its aid.

If two compost heaps are to be prepared, lime should be the basis of the one, and stable dung of the other, for the sake of comparison ([278]).

From the perusal of this section, it evidently appears, what endless sources of fertility may be obtained by the active and industrious farmer; and which, aided by judicious rotations of crops, can hardly fail to preserve his fields in a constant state of increasing productiveness. It were to be wished, however, that various doubtful points, regarding the nature and effect of manures, and the most advantageous modes of application, were ascertained by a series of experiments, tried on different soils, in different climates, and under different courses of crops. Agriculture will never reach that degree of perfection and certainty, which it ought to attain, until that measure be accomplished ([279]).

Sect. V.—*On Paring and Burning.*

Paring the surface of the soil, and burning the sods or turf thus obtained, is an operation in husbandry, highly advantageous when judiciously executed; though, if the subsequent tillage and crops be improper, the soil must necessarily be exhausted, and essentially deteriorated. Hence it need not excite wonder, that the utility of this practice has been much contested. The principles however, on which this mode of improvement is adopted, are now in a great measure ascertained.

In discussing this subject, it is proposed to consider,—The soils which are calculated for this operation;—The instruments used in paring;—The depth of the turf or sod;—The mode in which the burning should be conducted;—The expense;—The season;—The nature of the ashes, and the substances mixed with them;—Their management;—The crops which should immediately follow;—The rotations to be afterwards adopted;—The advantages of the practice;—Its disadvantages;—and the result of the whole inquiry.

1. *Soils.*—Paring and burning are, in general to be recommended, for the improvement of peat-mosses;—of unreclaimed lands, with a sufficient depth of soil;—of chalky downs;—sainfoin layers;—and old rough-swarded pastures. With regard to sandy soils, and also those distinguished for their fertility, the practice ought not to be adopted, unless under very peculiar circumstances.

Fens, and Peat-mosses.—It is scarcely possible to improve fen and peaty soils from a state of nature, to that of profitable cultivation, and in many cases, they cannot afterwards be continued in an arable state, without the assistance of fire ([280]). The spontaneous growth is so worthless, that it must be destroyed; and this is most readily and effectually accomplished by paring and burning, operations to which these soils are peculiarly well calculated. The surface is easily pared;—the soil is more inflammable than any other; —and the turf can be converted into ashes at a moderate expense (281).

Unreclaimed Lands.—Where the soil is in a wild uncultivated state, and its vegetative powers in a great measure dormant and inactive, they cannot be called into full action without some stimulus. In that case, the ashes produced by sod-burning, with the aid of lime, are generally necessary, and always effectual (282). Indeed where land, covered with thick-tufted coarse grass, is broken up and sown without having previously undergone this process, the old rubbish carries most of the moisture from the seed, and proves a harbour for grubs, slugs, and other vermin (283); whereas when the turf is burnt, these enemies to cultivation are destroyed,—the causes of sterility are removed,—and in its stead, a fertilizing power is created, which, without the aid of this process, could not have been obtained (284).

It is remarked in a work distinguished for its ability, *that the difference between the two methods of breaking up rough ground, (either paring and burning, or ploughing merely), is more than the value of the freehold in favour of the former. The one opens an immediate source of great profit; whereas the other generally leads to expense and disappointment* (285).

Chalky Downs.—There can be no doubt, that the system of paring and burning, is peculiarly applicable to chalky downs. Mr Boys of Kent has given a detailed account of experiments, tried on 267 acres, principally consisting of such downs, and, when the season proved favourable, with uniform success. A single crop thus raised, was often equal to the value of the land in its original state (286). These, and a number of other experiments equally satisfactory, are decisive of the question, that downs and other pastures, ought not to be preserved for the sole purpose of being enabled to fold sheep on the arable land in the neighbourhood, with a view of enriching it, when they can be pared and burnt, and brought into cultivation with such advantage (287).

Sainfoin Layers.—Wherever there are old sainfoin layers which ought to be broken up, paring and burning are essential for the destruction of the insects, with which such land is usually infested. The utility of this practice has been proved in numerous instances.

Old Pastures.—Many soils formerly cultivated, have been subsequently neglected, till their surface has become mossy, and unproductive, or covered with a luxuriant crop of useless weeds, or coarse herbage. In these cases, paring and burning is the proper system to render such land fit for vegetation. Experiments have been tried of its effects, compared to ploughing merely, and the result has been, that the burnt part, after yielding crops superior to the others in tillage, was free from rushes, and covered with sweet grasses, but that the other part, when laid down in grass, was full of rushes, and coarse herbage ([288]). Indeed, whereever *old swards*, full of matted vegetable fibres, are broken up, they ought always to be treated in that way. But this observation, is not applicable to land that has lain only a few years in grass; or to any land capable of producing good crops of grain, immediately on being ploughed ([289]).

Sandy Soils.—It can hardly be imagined, that fire would add any thing to the nature of sand, or render it more fertile. In the opinion of an eminent chemist, sandy soils cannot be pared or burnt to advantage ([290]); and as the tendency of its operation on such a soil, would be to lessen any small degree of cohesion which it may possess, from whatever cause arising, it must on that account be prejudicial ([291]).

Fertile Soils.—Where the soil produces sweet herbage, and contains a just mixture of good earth, or where the texture is already sufficiently loose, paring and burning ought not to be practised ([292]), nor ought turf, *that will readily harrow to pieces*, be subjected to these processes.

The practice, therefore, in Devonshire ([293]) and Cornwall, of paring and burning *their dry-stapled lands*, as a preparation for wheat, seems to be carried to an extreme, which demands the attention of those who are interested in preserving the permanent fertility, and agricultural resources, of these important districts. The soil there, naturally produces clean, sweet herbage, and never would become so coarse and rough-skinned, as to require that operation. Hence, an intelligent observer, has recommended it to the men of landed property in that county, to guard against the abuse of this practice ([294]). In Ireland also, it appears, that paring and burning the soil, for obtaining potatoe crops, have been carried to a very pernicious excess, and that much injury will be sustained, both by the landlords and by the public, if this practice is not put under some useful restrictions ([295]).

2. *The Instruments used for paring.*—The instruments pe-

culiar to this operation are, The fen-plough;—The breast-plough;—The cobbing-hoe;—and, The prong-spade.

The fen-plough has been already briefly described, (Chap. II. Sect. 7). In regard to the breast-plough, or paring shovel, it is calculated to be worked by men. The upper part is made of wood, with a *share* of iron, with which the sod is cut. This instrument is pushed on by means of a hilt at the top; the labour is excessive, but a good hand will pare about an acre in a week, or rather more, if the work be smooth, and free from impediments ([296]). The cobbing-hoe, (*ecobue*), is a French tool for cutting and raising up pieces of turf, growing on coarse and rough lands, which cannot be pared by the common breast-plough. The prong-spade, is a tool in the shape of the common spade, but with three or four prongs instead of a plate. It is used for digging the turf on the sides of waste-banks, &c. where the soil is too full of flints or stones, to admit readily the common, or plate-spade. It enters the ground with much less labour than the common spade, and raises the turf equally well ([297]).

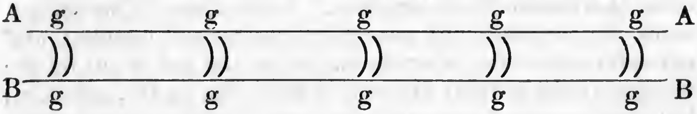
The common plough is also frequently made use of, and, in many situations, it is the best instrument for the purpose; particularly when, instead of the usual share, it is equipped with a paring-spade. By using it, the business proceeds with greater dispatch, and is attended with less expense in the previous cuttings, though by this mode it costs more for burning; but then a greater quantity of the soil is pulverized, and prepared for the ensuing crops, than when the breast-plough is employed ([298]).

Where the plough is used, and the soil is a peat-moss, the horses must often be accommodated with wooden pattens; a particular description of which, with engravings, is given in the Communications to the Board of Agriculture ([299]). In the fen districts, particular attention is paid, to have horses with broad hoofs, that they may be enabled to tread the soft soil with more safety. By their going unshod for some time, broad hoofs are acquired.

3. *The Depth.*—The usual depths are, from about one to six inches ([300]). In shallow soils the turf cannot be too thin. In Devonshire indeed, they endeavour, by cutting them in small pieces, and driving them about by harrows, to shake out the earth, and to leave nothing but the grasses and their roots to burn. Two inches are generally thought sufficient; but the late Mr Wilkes of Measham, in Derbyshire, frequently ploughed old, rough pastures, eight or nine inches

deep, and burnt the whole furrow; and with the ashes, he manured not only the land pared, but as much more [301]. This, however, was rather burning the soil, than paring and burning the surface.

4. *Modes of burning the Sods.*—When the sod or turf is pared by any of these means, it is dried preparatory to burning. This is commonly done by letting the sods lie for several days, as the paring implement left them, thus drying their earthy side; then turning the grassy side upwards for two or three days; and if more drying should be necessary, they are placed for a day or two on their edges, two sods supporting each other, by which both sides may dry at the same time. The burning process may be facilitated, in moist seasons and climates, by the use of portable furnaces, made of old iron hoops of the following figure and dimensions:



The two rods, A and B, lie flat on the ground. The small hoops, *g* and *g*, are rivetted on them. The implement is four feet long, and so light, that a boy can carry it. Turf, after being dried a few hours, may thus be burnt; for if it be laid on the top of the apparatus, with the grass side downwards, the opening left, through which the air passes, necessarily encourages the operation of burning.

In general, however, the sod or turf is burnt, either in small heaps,—in large ones,—or spread on the surface.

It is most convenient for the workmen, to collect the sods in small heaps on the field, ten or twelve feet apart, and to fire the heaps by a few red-hot ashes, taken from the heaps that had been previously fired.

Mr Boys strongly recommends large heaps, each containing twenty cart-loads, as more advantageous than small ones. There would thus be more inside. If properly conducted, more of the inside of the heap would be converted, by the smothering process, into a carbonaceous substance, by which the ashes acquire more fertilizing properties [302].

In one instance, instead of the sward being collected into heaps, it was burnt all over the surface [303], in the state in which it was left by the paring spade, and merely charred, instead of being reduced into ashes. This plan was attended with the best effects; for though the former produce was merely heath and ling, yet the ground yielded spontaneously, a most luxuriant crop of grass, which continued permanent [304]. There is something resulting from heat, applied to the surface of the soil, the advantages of which are not yet sufficiently understood [305]. It certainly contributes to render the soil more porous, and of a texture through which both air and moisture can more freely penetrate.

5. *The Expense.*—This must depend on various circumstances; as, 1. The nature of the soil on which the operation is to be performed, and the interruptions and obstacles that may occur [306];—2. The price of labour at the time;—3. The instruments that are used;—4. The skill of the labourers employed; and,—5. The state of the weather. But in general it may be remarked, that there is scarcely any process, accompanied with such beneficial effects as that of paring and burning, if properly applied, or one that can be done at so moderate an expense. In the fens of Cambridgeshire, for instance, the charges of paring and burning, and spreading the ashes afterwards, (when the sod is cut by the plough), costs only at the rate of from 12*s.* to 15*s.* per acre; but the manner of executing the work by the plough, is there brought to the greatest possible perfection. In other districts, where this operation is less practised, it may be stated at from 20*s.* to 30*s.* per acre. When the breast-plough is used, the amount, which in Kent was formerly only from 25*s.* to 30*s.*, was raised, in 1803, to 50*s.* per acre [307]. Even at that sum, or still higher, the expense can be no objection, when it is considered, that on soils suited for the purpose, it is repaid by the first crop;—that this crop furnishes materials that will produce manure for the succeeding crops;—and that land thus brought into cultivation, if cautiously treated, under a rotation of alternate green and white crops, and then laid down well manured, and in good order, into grass, will continue productive for a series of years [308].

6. *The Season.*—The *paring*, in favourable seasons, may commence in February; and the sods will thus be ready to receive the beneficial influence of the north-east winds, which are so usual in spring, and which are distinguished by their drying properties. The paring, however, should always be executed in a dry season, to prevent the sods getting into a growing state. The *burning* may begin in March, and be continued till the end of October. What is earliest done, may be planted with potatoes; the next in succession may be sown with turnips; in July with rape; and what is executed later, may be reserved for winter rye, or, in good soils,

for wheat. Thus the improvement would never stop, while the weather permitted the processes to be continued [309].

7. *Nature of the Ashes, and the Substances mixed with them.*—It is proved by innumerable trials, that the substances produced by paring and burning, constitute a most powerful manure, and that greater crops may be thus procured, than by any other means. That much benefit results from these substances, is put beyond doubt by the circumstance, that if they are removed, the succeeding crop suffers greatly [310]. The nature of these substances may be thus explained:—1. When the earth has been thoroughly heated by fire, its particles, if separated, lose the quality of coalescing; it freely admits, therefore, the delicate fibrous roots of young plants, and thus promotes their vegetation. 2. Another property which these substances possess, is, the power of imbibing water, and retaining it in the earth, for the purposes of vegetation; and hence their utility, in all those thin and chalky soils, where moisture is desirable [311]. 3. Soils susceptible of the greatest improvement from burning, contain a considerable portion of oxide of iron, which the process tends to decompose, and the oxygen thus obtained, may unite with the carbon of the ashes, and produce great fertility. 4. After it cools, the earth probably retains latent heat, which it may communicate to growing plants [312]. The carbonaceous matter produced by burning is, however, the substance of the greatest importance. Though the charcoal of perfect wood, or of pit-coal, has hitherto been found insoluble, that of the smaller sorts of vegetables readily dissolves in water, and administers food to plants. Great care should therefore be taken, to conduct the process of burning in such a manner, as to preserve this useful article. This may be done effectually, by burning the turf in large heaps, covered with fine mould, so as to keep up a slow smothering fire; and in this way, the whole vegetable matter contained in the turf, may be converted into a carbonaceous substance [313]. Burning should never be carried so far, as some writers have recommended. It is sufficient, if the living vegetable principle in the plants, and in their roots, is destroyed, and the texture of the mass so completely reduced, that it may become a productive soil. Hence, all violence of heat is to be avoided, and a slow smothering fire, is the object to be kept in view [314].

8. *Mode of managing the Ashes.*—There are four modes. 1. To spread and plough immediately after they are burnt. This is the common method, and probably the best [315];

though it is not always practicable. 2. To spread the ashes on the surface, exposed to atmospheric influence, for some months before they are ploughed in. This is done from an idea, (perhaps an erroneous one), that the ashes imbibe some matter from the atmosphere, which adds to their fertilizing qualities ([316]). 3. To leave the ashes in heaps, and to spread them before ploughing for wheat; a plan not to be approved of, as the alkaline salts will be washed out by the rains; and while the ground on the burnt spot will be saturated, the effete ashes will be of little or no benefit to the circle around. And, 4. After the land is pared and burnt, to spread lime, at the rate of 150 Winchester bushels per acre, with the ashes upon the surface, any time before the middle of October; the ashes and lime to be immediately ploughed in, by which plan a good crop is insured in the succeeding year ([317]).

Two rules connected with this branch of the subject, may be mentioned. 1. To sow the seed as soon as possible after the ashes have been spread, and ploughed in; for they operate much more powerfully, when in a caustic state, and the crop will be more abundant; and, 2. To mix lime with the ashes. The two manures seem to assist each other; and indeed, unless there is calcareous matter in the soil, various crops, in particular barley, pease ([318]), wheat or clover, cannot be expected to succeed.

9. *Crops.*—It is extremely material, that the first crop to which the ashes are applied, should not be of an exhausting quality ([319]). Turnips, rape, or tares, are generally recommended ([320]); or potatoes, when the ashes are got early, and some dung can be applied. In regard to turnips, the advantages to be derived from that crop, by means of paring and burning, on land where perhaps they were never seen before, and where they could hardly be otherwise obtained, are inestimable. Each acre, in proportion to the goodness of the crop, will support from five to twelve sheep, during five of the worst winter months; and these animals, besides enriching the soil with their dung and urine, will render the land firm, so as to furnish an excellent tilth, for a crop of barley or oats, in the ensuing season ([321]). It cannot be too strongly inculcated, that it is by the extirpation of weeds, under the turnip husbandry, that the operations of paring and burning, on chalky soils, produce their most beneficial effects ([322]).

In Scotland, on peaty soils, potatoe-oats are accounted the most profitable first crop, being both early and less liaable to lodge than any other sort. They are likewise the most valuable variety of that grain; but they are considered a very scourging crop, and, besides the ashes, 150 Winchester bushels of lime ought to be applied per acre ([323]).

10. *Rotation of Crops.*—This must depend entirely upon the nature of the soil.

In chalky downs, the following system seems highly advantageous: 1st year, Turnips, or tares, as already mentioned; 2d, Barley or oats: if these crops are sown early, and kept clean from weeds, the result probably will be, a crop equal in value to the fee-simple of the land in its original state; 3d, Clover, trefoil, or rye-grass, sown with the preceding crop, to be eaten by sheep ([324]); 4th, Wheat, which will probably be equal in value to *double* the fee-simple of the land, before it was improved by paring and burning; 5th, Tares, or turnips, or both in succession, and eaten upon the land, which should be previously manured, in proportion to the two years' straw of the crops which it had produced, mixed with any earthy substances that can be obtained. Thus a foundation is laid for a fresh succession of similar crops, while the land, after the original paring and burning, is immediately placed in the highest state of productiveness and improvement ([325]). Most of the sheep pastures and downs, by this system, may be loaded with the heaviest crops of herbs, roots, and corn; and these, through the medium of a vastly increased number of inhabitants and domesticated animals, would yield to the public, from L.7 to even L.12 per acre, from lands, which at no time before had produced as many shillings ([326]).

For such soils, however, laying them down with *sainfoin*, as soon as they can be got into good order, is the most eligible plan, as it produces great crops of the best hay, for two years in succession, and for several years after, excellent pasture for sheep.

When oats are taken as a first crop, according to the practice in Scotland, dung can partly be procured, *from the produce of the soil itself*, for raising a crop of either potatoes or turnips, in the succeeding year; but the former is almost always preferred. It is a good rule, that dung should be applied the second year after burning; for half the quantity would do more good at that time, than double the quantity at any time afterwards. After potatoes or turnips, with dung, an abundant crop of grain, and next of grass, may be obtained, and then excellent pasture. The great object is, to lay down the land, as soon as it is practicable, with the grasses best adapted to the soil; and to let it remain in that state, as long as it continues productive. For peat-moss, the soft meadow-grass, *(holcus lanatus)*, with a mixture of rib-grass, is recommended. Marl-grass, with some meadow foxtail, and a small mixture of the Pacy rye-grass, will likewise answer well on such soils. Marl-grass, or cow-grass, though resembling red clover in appearance, has quite different effects. It is friendly to all natural grasses growing with it, which clover is not. It is safe for cattle, when cut in a green state for soiling; and not so dangerous to the wind of horses, when made into hay ([327]). For drier soils, the seeds required are, four pounds of red clover, five pounds of white, and one bushel of rye-grass; and if the land be continued in grass for six or seven years, another rotation may then be commenced ([328]).

A new mode of paring and burning has been tried in Derbyshire; that of paring the stubbles, and burning, in small heaps, the straw, weeds, roots, and part of the soil. The ashes are then spread, mixed with lime; and sometimes, on this preparation, wheat is sown after oats, or stubble turnips, followed by oats next spring ([329]). This practice is exhausting, when a crop is immediately taken; but if it were applied to clay soils, *preparatory to a fallow*, it might meliorate their texture, and destroy a number of weeds.

11. *Advantages.*—The benefits resulting from paring and burning, are numerous and important. 1. By these processes, the various tribes of grubs and insects, which lodge in the surface of the soil, are destroyed ([330]). 2. By the same means, the seeds of many weeds are consumed, by which the crops would otherwise have been injured ([331]). 3. Not only are the stems and leaves of shrubs, furze, heath, ferns, &c. destroyed, converted into charcoal, and thus prepared for the food of plants, but by extirpating the old sickly roots, room is left for others, younger and more vigorous ([332]). 4. The soil is at once more completely pulverised. 5. The texture of soils, which in their natural state are tough, tenacious, and unfit for corn crops, is improved, and prepared for cultivation. 6. By paring and burning, manure is obtained, at a trifling expense, at the commencement of the improvement; it is found on the spot, free from carriage, which in some cases costs more than the manure itself; and a stock of that necessary article is thus procured, which, under judicious management, may serve to keep the land in fertility, until it shall be brought into a regular course of husbandry. These are important advantages; and he must

be a bad farmer, who cannot continue, for any length of time, land so enriched, in a high state of productiveness ([333]). 7 Even the heat communicated to the soil by burning ([334]), and the mixture of a substance that has passed through fire, is found to be highly advantageous.

12. *Disadvantages.*—Among the objections to this practice, it is urged by some that shallow soils are thus rendered shallower. But others maintain, that the earthy parts of the soil are neither consumed nor diminished by burning ([335]): for though the bulk of the sod or turf be diminished, this arises solely from the burning of the roots and vegetable substances ([336]). Shallow soils, it is contended, are more improved by the process, than any other; for when thus managed, more of the subsoil can be safely incorporated with them ([337]). It is likewise said, that as the animal and vegetable matters contained in the turf are destroyed, the ashes cannot possess any real fertilizing quality: but the crops produced by these ashes amply refute that assertion. It is farther maintained, that the soil is thus deprived of its natural grasses; but it is also thus deprived of its *natural weeds*, which is a most material object. In regard to grasses, the artificial ones thus raised, afford a much more abundant and valuable article of produce, and more useful as fodder, than all the natural grasses; which, on lands, such as those usually pared and burnt, are generally of the worst sorts.

Some persons have asserted that it would be a better plan, *to pare only*, and to put the parings in heaps, there to remain till the mass be reduced into mould; when these heaps might be spread on the land from which they came. This, however, is a laborious and expensive process, which it would require a considerable period of time to perfect, and which, after all, would be much less effectual than paring and burning ([338]).

In regard to more general objections:—that it dissipates what ought to be retained;—annihilates oils and mucilage; —calcines salts;—and reduces fertile organic matter into ashes of very weak efficacy;—it may be answered, that they seem to be either unfounded in fact, or that all these mischiefs are principally to be attributed to the abuse of the system, and are not found to be connected with it, under judicious management ([339]).

13. *The Result.*—By the process of paring and burning, a stiff, damp, and consequently a cold soil, will be converted into one that is friable, dry, and warm, and much more

proper as a bed for vegetation. Though some animal or vegetable matter, or manure previously in the soil, may thus be dissipated, yet such temporary disadvantages, are abundantly counterbalanced, by the destruction of the seeds of weeds, the roots of coarse shrubs, and the larvæ of insects with which such soils are infested, as well as by the texture of the soil being permanently improved. In regard to soils in which there is an excess of inert vegetable matter, the getting rid of that excess must be beneficial; for the remainder will be rendered fitter for cultivated crops, not only by the addition of calcareous earth, but by the carbonaceous matter remaining in the ashes, which is likely to be more useful, than the coarse vegetable fibre from which it was produced ([340]). By this process also, not only a stimulant, but nutriment for plants is prepared.

It is evident, that this practice cannot be either so general, or so successful, in a wet climate like that of Scotland, as in a country having a less humid atmosphere, and consequently a greater space of time, in which the process can be carried on; but still it is a means of improvement, which is entitled to be thoroughly investigated, wherever the cultivation of the soil is an object of inquiry.

Sect. VI.—*On Summer Fallowing.*

Over the greater part of Europe, it was long considered as an advantageous practice, occasionally to dedicate an entire season, to the cultivation of arable land, without raising from it any crop. The expense of the process, it was supposed, would be amply compensated, by the texture of the soil being ameliorated, by the destruction of weeds and insects, which would thus be effected, and by the increased produce of the succeeding crops. But when the rent of land was increased;—when the expenses of cultivation were augmented;—when cleansing crops, as turnips, were introduced;—and when the productions of the soil became more valuable, it was natural for the farmer to consider, whether such great sacrifices were really necessary; and whether fallows might not, in many cases, be diminished; and in others totally given up. On this subject, a controversy has arisen between two sects, the fallowists, and anti-fallowists, which has been conducted with much keenness and ability ([341]).

Of late years, the question at issue, has been much narrowed. It is now, on all sides, admitted, that light soils, (where the culture of turnips is eligible), need not be kept in an unproductive state; and that on strong lands, under a judicious system, summer fallows are not required, more than once in the course of a rotation. The subject under discussion therefore, is reduced to this short question:

Is it for the interest of a farmer, who cultivates cold, strong, clayey, adhesive, and wet-bottomed lands, periodically to fallow them (342)?

The question shall be considered as applicable to the climate, 1. Of Scotland; 2. Of England; and 3. Of Ireland.

1. *Scotland.*

Wherever the soil is of the nature above described, it is the universal opinion of the most intelligent and experienced farmers in Scotland, that a summer fallow cannot be dispensed with, for the following reasons:

1. Strong clayey soils, if constantly cropped, must often be ploughed and harrowed in a wet state: hence, in a moist climate, they lose their fertility, become hard and stubborn, impervious to the sun and air, as well as to the roots of plants, and require repeated exposure to the atmosphere, before these defects can be corrected. By a complete summer fallow, they are rendered tender and mellow. A tilth is given to them, superior to what can be obtained from a fallow crop, while the soil is rendered so friable, as to resemble that of a garden.

2. The grand object with the skilful agriculturist is, to keep his lands clear of weeds of all sorts; and on strong soils, summer fallow, properly conducted, has ever been found *a sure method* of accomplishing that object. During the short period of dry weather to be found in spring, in such a climate as that of Scotland, the foulness contracted, during the time the land is under crop, cannot always be got the better of, even by a whole summer's labour; any expectations, therefore, of successfully cleansing such land, during spring alone, and thereby abolishing summer fallows, cannot be well founded. Nor will hoeing crops answer, for the proper time to clean the land effectually is in July and August, *and it must be accompanied by deep ploughing*, which can never be performed, if the land be under a crop. Besides, under no other process, can that noxious weed the thistle, be so effectually extirpated.

3. Fallowing is found to contribute essentially to the destruction of snails, and other vermin in the ground; not

only by destroying them, and their eggs, in the course of the operation, but by exposing them to the attacks of rooks and other birds.

4. Its advantages for pulverizing, mellowing, and drying the soil; converting the roots and other remains of vegetables into soluble matter, as food for succeeding crops; for enabling the farmer to remove all obstructions to perfect tillage; and to adjust the surface, so as to promote the discharge of water, and to facilitate future culture, can hardly be questioned.

5. During the fallow process, the land may in every respect be brought into perfect order. All the small drains in the field may be repaired; lime and other manures may be applied at a proper time, and thoroughly incorporated with the soil. A well-conducted fallow, is more favourable to *the early sowing* of wheat, than a previous crop of beans; indeed on clay soils, in a northern climate, it is impracticable to sow wheat extensively, unless a considerable part of the land has been prepared during the summer months. It is, indeed, almost uniformly observed, that the grain of wheat crops, sown upon regular fallows in September, or early in October, is of the best quality, probably owing to their receiving the greatest heat of the sun, and thereby reaching maturity earlier.

6. But in no other way, than by a summer fallow, can the clay land farmer depend upon a good crop of grasses. Where beans are cultivated, the roots take away that nourishment from the earth, by which the clover root should be fed. The bean also encourages the white snail, a determined enemy to clover. But the year after a fallow, the land rarely fails to produce a crop of clover in great abundance. There is no sacrifice that ought not to be made, to secure a large crop of clover; since, either for soiling, or as hay, it goes much farther in feeding horses or cattle, than any of the green crops that can be raised on a clay soil. Its roots also are so bulky, as to enrich every soil on which it is cultivated.

7. Another advantage of a complete fallow is, that less manure will produce an abundant crop, than when the practice is either neglected, or imperfectly executed. This is an object of much importance, a scarcity of manure, being the greatest evil, with which the arable farmer has to contend; and this fully compensates for the want of a crop, which is so strongly urged against the fallow system.

8. Exposition to the atmosphere is another advantage.

The most stubborn, and unfertile soil, if exposed to atmospheric influence, will be improved in its texture, and rendered much better calculated for the process of vegetation. This is effected, either by the soil acquiring properties from the atmosphere, or by those substances which rendered it barren, being neutralized, destroyed, or washed away. The fact is, that by no other means but by a complete summer fallow, can a wet-bottomed clay be freed sufficiently of the moisture it has imbibed, which having been long locked up in the soil, holds saline and mineral matters in solution. These matters being discharged, the soil readily imbibes fresh water, and gets into a mellow and fertile state.

By these means, the soil becomes more friable, the crops which it produces are vigorous, and abundant, and, comparatively speaking, free from weeds.

Some have suggested, that instead of a fallow, the land should be trenched. But even if hands could be procured, heavy clay, the soil which it is alone necessary to fallow, is seldom fit to be dug, as the rain makes it too compact in winter, and in summer, the heat makes it too hard. In Flanders, where so much land is trenched, light soils are preferred for that operation, and it is frequently done by the shovel instead of the spade [343].

The expense, and the practicability of subsituting a crop in its stead, are next to be considered.

The expense attending this process is considerable. It must vary according to the amount of the rent, and the number of ploughings, harrowings, &c., but the following is considered to be a fair average statement:

	Per Statute Acre.		
The six ploughings, harrowings, &c. cost	L.3	11	0
Rent for two years, at L.2, 7s. per acre per ann.	4	14	0
	L. 8	5	0 [344]

Besides these sums, the expense of the crop to be raised, and its share of the manure, required for the whole rotation, have to be added. But the advocates for fallowing maintain, that these ploughings, and the rent of the land while in fallow, ought not to be charged against the subsequent crop, but to the whole crops in the rotation, as they are all, in a greater or lesser degree, benefited by it.

From the objections urged against a summer fallow, various attempts have been made in Scotland to omit it, but hitherto unsuccessfully. *Beans* were tried, and they are certainly well calculated for strong soils, being an excellent preparation for wheat. When drilled, they enable the farmer in some measure to keep his land longer in a clean state, than could be done were that operation to be omitted. Yet their culture cannot prevent fallow from being necessary at certain periods, when the land becomes foul and hard by cropping. *Potatoes*, planted on part of a fallowed field where the soil was favourable, with a greater allowance of manure than the naked fallow, proved so severe a crop, that the part cultivated with potatoes, yielded a less crop of wheat, than the ground that had been fallowed:—the after crops on the fallowed part, were likewise more abundant; and the land much cleaner in the end. *Swedish turnips* were also *sown early*, and taken off the field in September; but the soil was found to be so much exhausted by that root, that the succeeding crop of wheat was less than the usual average.

On this subject, so far as respects Scotland, it may be proper to add, that a great reduction in the frequency of fallows, has already taken place, since the introduction of the turnip husbandry on light land; and though on the clayey adhesive soils above described, they can hardly be ever totally abolished, in that part of the united kingdom, yet there is ground to hope, that in process of time, circumstances may occur, which may prevent the necessity of recurring to them, even so often as is requisite at present. The climate may improve as cultivation is extended;—by more effectual draining, and the frequent additions of lime and dung, the texture of the strongest soil will be altered, and necessarily become more of a loamy nature;—by repeated cleanings, the quantity of weeds, of all descriptions, must be greatly lessened;—instruments also may be invented, which may prove more effectual for cleansing and pulverizing the soil, than those at present in use;—new plants may likewise be discovered, or a more advantageous mode of cultivating old ones may be introduced;—and it is impossible to foresee, what improvements may be effected by draining; in consequence of which, the cultivation of wet and strong soils may be facilitated, and either stock may be fed upon the ground, or its produce may be removed with less injury. But till these alterations take place, the Scottish farmer will not easily be induced to relinquish the advantages he derives from a well-executed summer fallow.

2. *England.*

The climate of England is certainly superior to that of Scotland; yet even in that part of the kingdom, many respectable authorities consider an occasional fallow to be necessary.

Mr Marshall states, that if land be in a state of foulness with root-weeds, (as half of the old arable lands of the kingdom may be said to be), a year's fallow is *the shortest, the most effectual, and the cheapest* way of cleansing it ([345]). He also accounts it the best preventive of the wire-worm. All herbivorous insects, which have not the power of flight, at least in their early states, are best extirpated, by keeping the soil which they inhabit free from every thing herbaceous, especially during the summer months, when they are in a state of activity, and doubtless require daily support. In that case, unabating tillage must prove their destruction ([346]).

In Kent, they have what are called *autumnal fallows,* in which way the stubbles of fallow crops are prepared for wheat, by several ploughings and harrowings. Barley also is sown late, that it may be thrice ploughed, and operate as a cleansing crop; but after all, the intelligent Reporter of the Husbandry of Kent, (Mr Boys), states, that there are some untoward soils, which all the art and industry of man cannot keep clean and in good order, for any considerable length of time without a fallow; that cold and wet clays, if they were tolerably clear from weeds, are subject, after two or three crops, to run together, to become exceedingly stiff, and to require the intervention of a summer fallow to mellow the soil; that a good summer fallow is the best preparation for a crop of clover;—and that the course of, 1. Fallow; 2. Barley; 3. Clover, or beans; and, 4. Wheat, which is the system most practised in the Isle of Thanet, is there considered to be, *the foundation of all good management* ([347]). In Essex, fallowing is thought essential, especially for barley. In some parts of the county, half the arable land is under a dead summer fallow; in others, a fourth, a fifth, or a sixth; but the practice is universal, except on dry turnip soils ([348]). Mr Cheere of Cambridgeshire is convinced, by much experience, that a perfect clean fallow, is indispensable every four, five, or six years. It is necessary, however, that all the requisite ploughings should be given in dry weather.

That celebrated Norfolk farmer, Mr Overman, gave a strong proof of his concurring in that opinion; for entering upon a farm, where some fields were full of spear-grass, and other weeds, he gave the outgoing tenant L. 5, 10*s*. per acre, for the privilege of completely fallowing them. He cleaned the ground thoroughly by four ploughings. The soil was sandy, on which a hot July sun destroyed the root-weeds, without raking or burning ([349]). Such are the effects of climate.

The Reporter of the Husbandry of Staffordshire, (Mr William Pitt), explains, in an able manner, the advantages of summer fallows; acknowledging, at the same time, that he had once been a sufferer, by too implicit a confidence in the opposite theory. He says, that fallowing for wheat, is practised by the best farmers, on cold, wet, or strong lands; and that he who shall attempt to manage such lands without fallowing, will most probably find his mistake. Fallowing is there necessary, because the roots of perennial grasses, such as couch grass, &c. cannot otherwise be sufficiently weakened or extirpated; nor can any attempt at extirpation be so successful, by any other means, *as by repeated deep summer ploughings* ([350]). It appears also, from the Derbyshire Report ([351]), that whenever the soil is strong, clayey, adhesive, and wet-bottomed, many intelligent farmers in that district, approve of summer fallowing.

There is a most striking coincidence between these, and Mr Boys's remarks, and the doctrines already detailed on the importance of fallows, from farmers residing in Scotland, though there could not be any previous knowledge that they followed the same practice, and approved of it on the same grounds.

Mr Curwen also states, in a recent publication, that the practice of fallowing the more distant parts of his farm, has, with great reluctance, been adopted by him. This practice he considers both requisite and beneficial, in so wet a climate as that of Cumberland, where it is wholly impracticable, in all seasons, to make green crops so free from couch and other weeds, as is necessary for the successful cultivation of the succeeding crops, particularly those of clover ([352]).

But as the system of fallowing is condemned by authors of great eminence, in reference to southern districts, as either rarely, or not at all admissible, even on strong soils, we shall briefly state their sentiments upon the subject.

Mr Young only admits a fallow during the first course, advising it to be rejected the second course, and ever afterwards ([353]).

Mr Marshall is of opinion, that when land is once thoroughly cleansed, it may, by fallow-crops, and due attention, be kept so for a number of years; and more especially, that where the farmers attend so particularly to the seed and vegetating processes, as in the Vale of Gloucester, a whole year's fallow, judiciously made, will be found sufficient to keep land in a state of tilth and cleanness, for ten, fifteen, or perhaps twenty years (354). In another work he maintains, that after an eighteen months' fallow, land may be *so effectually reclaimed*, that it would not require a repetition of the operation of fallowing, *for half a century afterwards.*

But the author who most decidedly disapproves of the summer fallowing system, is Mr Middleton, the Reporter of Middlesex. Instead of a naked fallow, he recommends a crop of winter tares, which may be obtained in perfection before Midsummer. It is the nature of this crop, he observes, while growing, to render the soil more mellow, than is done by a fallow. It tends to enrich the land, by retaining the air stagnant while the crop is growing; and when the crop has reached maturity, it supports and fattens the farmer's stock. Green tares may be given in racks to cattle and sheep upon the land, if the season permits, or in folds, fixed in convenient parts of the fields. By either of these modes, the soil is abundantly fertilized by their dung and urine. The arguments in favour of a naked fallow, arising from a clay soil, and a moist climate, are thus in a great measure obviated, in districts where winter tares will thrive, and where they run no risk of being destroyed (355). As they delight in a moist climate, and, as in England, they come to maturity in June, and require to be taken off the ground during the driest months in the summer, the farmer has all the months of July, August, and September, to render his land as clean as a well-conditioned garden, and as fertile as he can desire (356).

3. *Ireland.*

In Ireland, the system of fallowing for wheat, is very generally adopted, in most of the corn countries, particularly in strong soils. It is, however, more generally practised by tillage farmers from necessity, than from any real advantage which they derive from it. Among the wealthy and intelligent tenantry, *fallow crops* are usually substituted, except in cases where the land requires draining, or some other operation that could not be performed, if under a crop. Fallowing on strong soils has yet, however, still many advocates, though all those lands which have been fallowed and cropped alternately, have progressively become less fertile ([357]); while those on which green crops have been substituted, have not been in the least deteriorated ([358]).

The arguments both for, and against summer fallow, are thus briefly stated, in reference to the circumstances of the three united kingdoms. Difference of climate, may render different systems, in this respect, advisable ([359]). Nothing, however, but a personal inspection of the crops grown in Berwickshire and the Lothians, can give an adequate idea of the perfection to which the fallow system is brought in those districts;—of the immense crops produced after it;—or of the advantages which are derived from a well-conducted fallow, by the subsequent crops in the rotation. In the culture of wet tenacious clays, therefore, the fallow process has been called, by an eminent farmer, (George Rennie, Esq. of Phantassie), "The main spring of Scottish husbandry;" and it appears from the evidence of an able and intelligent judge in those matters, (the late J. C. Curwen, Esq. M. P.) who had frequently examined the husbandry of the Lothians, "That clay soils, subject to this process, will produce the greatest crops, and yield the highest rents, of perhaps any in the united kingdom ([360])."

Sect. VII.—*On Weeding Land.*

Preventing the soil from being injured by weeds, is attended with much greater difficulties than are commonly imagined. It is not only important to free the cultivated soil, by every means that can possibly be devised, from those destructive intruders, and to prevent their growth, in grass lands, in plantations, and in commons, but also on the sides of roads, in hedges, or wherever they are to be found.

It is the more necessary to attend carefully to this subject, as the powers of propagation, which have been imparted by nature in this description of plants, render it extremely difficult for farmers to prevent their growth. Many of them are propagated both by their roots and their seeds. Some plants extend their roots so far under ground, that it becomes extremely difficult to dig them up. In some instances, new plants spring up from every joint left under ground. Others stretch out runners or stolons every way above ground, and to a considerable distance, while many plants form their seeds with wings, by means of which they are scattered about by the wind in every direction, and frequently to a considerable distance. These are so dangerous as to require, not only partial attention, but general efforts to have their future progress arrested, by cutting them down wherever they are to be met with, before, or as soon as they have flowered.

From a perusal of the County Reports it appears, that both in England and Scotland, weeding is too much neglected; though, in several districts, since the introduction of turnips and other cleansing crops, with row culture and a more correct mode of fallowing, the ground is kept much cleaner. But still on many farms, weeds continue to occupy a considerable portion of that surface, for which the farmer annually pays rent and taxes; and by their growth, the production of useful articles is considerably lessened.

In discussing this subject, it is proposed to consider—the various sorts of weeds;—the descriptions of lands in which they are respectively found, and how they may be eradicated;—the instruments made use of in weeding;—the expense of the process;—the means of preventing their increase;—the civil or legislative regulations which would contribute to their destruction;—and the advantages which would ensue, were their extirpation accomplished.

1. *Of Weeds in general.*

Weeds are commonly divided into three classes—*Annuals*, which continue only one year, the plant dying after its seeds are perfected; *Biennials*, which continue two years, and die after maturing their seeds the second year; and *Perennials*, which continue in existence several years. Many of these are propagated both from the root and from the seed.

These different sorts of weeds are found in corn-fields;—in grass-lands;—in hedges;—in waste and uncultivated lands;—and in woods and plantations; and even gardens, notwithstanding the care bestowed on their culture, are not exempted from them.

1. *Corn-Fields.*—In a list given by an intelligent author, of the weeds which infest our corn-fields, no less a number than *fifty-five* are enumerated ([361]). Fortunately their extirpation can in general be accomplished, by nearly the same processes.

The most effectual means of ensuring their destruction, on strong land, is by a clean and complete summer fallow; or on light soils by the culture of turnips, potatoes, or tares, in rows, and kept perfectly clean; but for the attainment of that object, it is necessary, 1. To bring the seeds within the limits of vegetation; and, 2. To destroy every weed which vegetates.

1. Seeds of an oily quality, such as those of charlock or field mustard (*raphanus, raphanistrum*, and *sinapis arvensis*), and several other annuals, will remain for a long period of time in the ground, capable of vegetation, when acted upon by moisture and heat. It is absolutely necessary, however, to make them germinate, before their destruction can be effected. This is accomplished by the operations of ploughing, harrowing and rolling, by which the ground is pulverized, and a vast number of seeds are brought so near the surface, as to promote their vegetation. In fallowing, those processes should be performed early in the season, when the powers of vegetation are the greatest, and the weeds most likely to come forward.

2. When the first crop of weeds appears above the surface, a second ploughing should be given, by which that crop will instantly be destroyed, and a foundation laid for producing another crop of weeds. Harrowing, and where there are clods, rolling should also be resorted to, after every ploughing; and in this way, several crops of weeds may be destroyed, in warm and moist seasons, before the succeeding crops are drilled. During the growth of those crops, both the hand and the horse hoe should be constantly employed; and the greatest care taken, to prevent all weeds from running to seed.

As the several hoeings given to the cleansing crops, destroy every annual weed as fast as it appears, if the seed-furrow, for the crop which succeeds, be not ploughed or scarified deeper than the last furrow given to the cleansing crop, (and a greater depth is then unnecessary), few weeds will appear in the crop of grain which follows; but as the clover stubble, which follows the grain crop, must be ploughed a little deeper than the seed furrow formerly given, a fresh growth of weeds may then be expected. To get the better of these enemies, some farmers hand-weed these crops, at an expense of from ten to twenty shillings per acre, and have found it much to their advantage; while others have resorted to the drill husbandry, and in that manner have been enabled to destroy them in a satisfactory manner.

By an attention to these measures, the quantity of weeds is regularly diminished; and many farms, which, forty years ago, were a nest of seed-weeds, are now brought into such order, that these injurious plants no longer materially impede the growth of corn (362).

Perennial Weeds.—It is much more difficult to eradicate perennial weeds, as several propagate both by their seeds, and their roots. Under this head are comprehended, all the sorts which come under the general name of couch, (*triticum repens*). These are among the greatest banes that husbandry has to contend with. They are sometimes so interwoven in the soil, when it has been negligently cultivated, as to form a species of matting. Their destruction can only be effected, by an early and complete summer fallow, when, by repeated ploughings, with sufficient harrowings between each ploughing, the roots may be worked out, and brought to the surface. The scarifier or grubber, and some recently invented harrows, are of peculiar service in extracting the couch, after the land has been completely pulverized. Besides collecting the roots by these instruments, it is an excellent practice, to gather them by hand-labour, employing boys and girls to follow the plough, and to pick up every root as fast as it is turned up. When collected, the roots, should either be burnt, or deposited in a large heap, and mixed with lime, and thus may become the basis of an excellent compost.

It is proper to observe, that the destruction of root-weeds, as couch, and of seedlings, as charlock, must be effected, in arable land, upon different principles; the former, by working them out of the soil in dry weather only; the latter, by pulverizing the soil, so as to induce the seed to germinate after rain, and afterwards ploughing in the young plants.

Among the perennial weeds affecting arable land, wild oats, thistles, docks, and coltsfoot, or tussilago, require particular attention.

The wild oat or oat-grass (*holcus avenaceus*) is a most troublesome weed to a farmer, and difficult to be eradicated. It formerly abounded so much in some districts, as to constitute almost one half of the crop. A farmer cleared a field of this weed by a most singular experiment. He dressed and manured it thoroughly, and sowed no crop, trusting to the oats. They grew up most abundantly. He cut them for hay, before the seed was ripe, and the field was never afterwards infested with that weed. Wild oats have likewise been extirpated by irrigation (363).

The common thistle (*cnicus lanceolatus*) and the field thistle (*cnicus arvensis*) are extremely injurious to all crops. They are for a time repressed, rather than destroyed, by a well-conducted summer fallow; but that is only a local remedy; for their numerous seeds, which are feathered, will often come from a considerable distance, and replenish the field that has been cleared. They are frequently cut close above the ground, by means of a very simple instrument, called a weed-hook; but it is done much more effectually, either by the hand, or by means of a pair of forceps or nippers with two long handles, by which the whole, or part of the roots are pulled up, and the plants either much weakened, or totally destroyed ([364]). In Derbyshire, they make use of a species of tongs, or pincers, *with fluted jaws*, which must be peculiarly effectual ([365]).

The dock, (*rumex crispus* and *obtusifolius*), is a hardy perennial, very tenacious of growth by its roots, and producing a great increase of seeds. In arable land, the roots should be carefully picked off during the tillage season, otherwise they will produce vigorous luxuriant plants, drawing much moisture and nourishment from the soil, to the injury of the intended crop. Docks ought to be pulled up by hand after heavy rains, when the soil is soft enough to allow their long tap-roots to be extracted without breaking, and long before the seeds approach towards ripeness, or even before they blossom. If the season be too dry for that operation, they ought at any rate to be cut and carried off ([366]).

Coltsfoot, (*tussilago farfara*), was long accounted almost unconquerable, even by a fallow, the seeds ripening so early in the spring, that they were usually shaken before the ground had got the second furrow. It is now, however, ascertained, that there is little difficulty in subduing this noxious weed. For that purpose, the plants must be destroyed in August, September, or October, after the crops of corn are cut, at which time they are at their full growth, and easily discovered. They ought then to be pulled up, and every stock or root that can be laid hold of, carried off. This should be done most carefully, for about an inch below the surface, the roots have a number of buds about the size of a pea, which, if allowed to remain till next spring, will flower, and shed their seeds in spite of every precaution. This plan should be persevered in for a few years, to give the experiment a fair trial ([367]).

By these means, more especially if accompanied by drilling, cultivated fields may be cleared from the dominion of weeds; and though these several processes are troublesome and expensive, yet they cannot be dispensed with, as they are the only sure methods known of eradicating weeds, for the plan of ploughing them in, (which, at any rate, can only answer in very deep soils), cannot be depended on.

It may not be improper here to notice, the great attention paid by the Flemish farmers to the weeding of their land; and as they know nothing of the drill husbandry in the culture of grain, the whole process is effected by manual labour. In the best cultivated districts, their exertions are incessant; and frequently from 20 to 30 women, may be seen employed in one field, kneeling, for the purpose of greater facility in seeing and extracting the weeds ([368]). In the Pays de Waes, where the soil is light, the trident, or *fourche a trois dents*, is made use of, after the several crops are harvested, to tear up the root-weeds; and the same tool is successfully employed, in breaking the clods in strong land, when they become dry, for enabling the root-weeds to be gathered, and facilitating the pulverization of the soil ([369]).

The clearing of arable lands from weeds, may in general be accomplished by, 1. Complete and well-managed fallows, whenever that operation is required; 2. By taking care that the manure used, is free from the seeds of weeds, or any roots that can vegetate; for which purpose, fermenting dunghills are advisable; 3. By a careful choice of clean seed-corn; 4. By short tillages, or not taking too many crops in a rotation; 5. By drilling crops, in soils applicable to that culture; 6. By attentive hand-weeding, and a spirited use of the hoe; 7. By the strictest attention to the choice of seeds, particularly those of grass, that no weeds are intermingled with them; 8. By weeding the land while in grass, so as not to suffer the seeds of any injurious plants to spread themselves; and, 9. By breaking up the land, by pursuing such a system of cropping, as will not increase or encourage weeds, and in particular, by adopting rotations in which green crops shall predominate ([370]).

On the subject of weeds in arable land, it is highly material to observe, that their seeds are often mixed with the grain, and when ground with it, render the bread unpalatable and unwholesome. Such weeds are universal enemies, from whose mischievous attacks no individual is exempted, and whose destruction, it is every one's interest, as well as duty, to promote ([371]).

2. *Grass Lands.*—It is difficult, in some cases, to discriminate, in meadows and pastures, between the useful plants and those that are injurious; but amidst the great variety which nature produces in such lands, there are several, which are not calculated to feed domesticated animals, and ought

therefore to be removed, for the introduction of others better adapted for that purpose. No person of common understanding, would ever think of allowing the live stock of his neighbours to feed upon his pastures, as the diminution of food to his own stock, by that circumstance, would be sufficiently obvious. A little consideration, however, may convince every individual, that a multitude of weeds, interspersed among his grasses, produce effects not less mischievous, than those that would ensue from such depredations of live stock. Yet from the Cheshire Report it appears, that in some of the best-conditioned pastures in that county, ragwort, docks, thistles, and knapweed, occupy at least half the land, to the exclusion of an equal number of useful plants ([372]).

Above twenty different kinds of weeds infest grass lands besides about thirty more, of less importance, whose characters are doubtful, or whose uses are not ascertained. Some of the most worthless, as the rush, *(juncus)*, and the sedge tribe, *(carex)*, may be got the better of by draining; others, like the mosses, *(musci)*, either by cultivation or manure; but there are a few which require individual attention, before they can be eradicated, in particular the dock, the thistle, and the rag-weed.

The dock has been already mentioned as a weed in arable lands. It is equally injurious to grass, both on account of its seeds and its roots. Its seeds are exceedingly numerous, and heavy, but the stem is flexible, and the recoil from a blast, with a high wind, spreads them to some distance. Docks are found to vegetate equally on turf, and on naked mould. Every bit of root forms a new plant, even after the heart has been consumed by a species of caterpillar. To eradicate this plant in grass lands, the root must be completely taken out by the dock-iron, at, or before the time of flowering, and thoroughly destroyed: this can generally be effected, after much rain. They are refused by cattle; but are eaten by fallow deer, which prevents their flourishing in parks. This plant is best exterminated when the ground is in pasture. It is said, that if it is cut in June, and the operation repeated as soon as the second shoot appears, the root is found to decay, and that it will not germinate a third time ([373]).

Thistles have also been mentioned as infesting arable lands. They are generally weeded out of the corn, but are too frequently left in full possession of the grass-land, by which much damage is incurred; yet these weeds are most successfully eradicated when the land is pastured, as they then stand detached, and can easily be destroyed. The thistle ought to be torn from the main root every year, when the plant is in its greatest vigour; the root itself is thus injured, gradually decays, and the plant is ultimately got rid of. They have been destroyed in a cow-pasture, by mowing the ground for hay, three years in succession ([374]), a full proof of the advantages of regularly cutting this plant for a succession of years. They ought to be let alone, till their blossoms begin to appear, for if cut in a young state, fresh shoots are produced from the sides of each plant. When mown in full bloom, the stem is hollow, by which the dew and rain descend into the heart of the plant, and occasion it to rot ([375]); yet as the blossoms in that state, are capable of ripening their seed, the safer way is, for the mowing to take place on the earliest appearance of the blossoms.

The rag-weed, *(senecio jacobæa)*, infests some fields more than even the thistle, especially when the soil is sound or dry, for it is seldom to be met with in wet lands. From the number of plants of this species, which are often seen crowding fine pastures, leaving little room for other herbage, it would seem, as if the possessors of the land, held it to be invincible. Sheep are very fond of its young leaves, probably bite off the crown on its first appearance, and thus contribute to banish it from the pastures on which they are fed. But all pastures cannot be occupied by sheep, and neither cows nor horses will touch it. The only effectual mode of destroying rag-weed, is to pull the plant up, just before the flower expands, which is commonly very practicable, as its fibrous roots do not penetrate deep, and are easily taken out after a plentiful shower ([376]).

From the large size of the weeds above mentioned, and the numbers of them which are frequently to be met with in grass land, it is obvious, that great damage is necessarily incurred; much of the herbage becomes inaccessible to pasturing animals; the soil is robbed of vegetable nourishment; and, in some cases, all the country round infested with flying seeds. The extirpation of weeds, therefore, is not only essential for the interest of the farmer, but a matter of general concern ([377]). On that account, it has been suggested, that every farmer should be obliged, under a statutory penalty, to cut over, in the course of the month of July, all those weeds that are to be found in his grass-lands, in his hedges, or upon the sides of any road that may lead through the farm he occupies. The effects of such a regulation would be highly beneficial (378); more especially when there is a malicious encouragement given to thistles or other weeds, as is sometimes the case (379).

3. *Weeds in Hedges.*—Both young and old hedges suffer greatly from the weeds which infest them, and of course their growth is considerably impeded. Indeed young quicks cannot thrive unless they are kept clean. Every weed growing in hedges is a nuisance, more especially, if it is suffered to ripen its seeds, which are liable to be carried into cultivated land by the wind, or conveyed by water to flooded or irrigated meadows (380). There are also some kinds of hedge-weeds, which bear the character of being hurtful to stock. On these accounts, all plants growing in hedges, more especially such as have winged seeds, should be extirpated, as useless in themselves, and often injurious to the neighbouring fields, or the domesticated animals which pasture in them.

4. *Weeds in Waste Lands.*—While lands of this description continue uncultivated, it is highly expedient, that, at the joint expense of the parties interested, (if they be held in common), measures should be taken for destroying weeds, and thus introducing better herbage. Furze and broom might thus be extirpated, and the land sown with hay-seeds in moist weather. Ferns should be mown and carried off in summer, their value, as litter, being well worth the labour. In Norfolk, they are mown by the cottagers, for fuel. Lands in common would thus be rendered capable of maintaining a greater number of stock.

As attention has seldom been paid to the draining of such lands, much stagnant water, and various bog weeds, are to be met with. These plants would give way to better herbage, if the bogs were drained; and this ought to be done, by a rate levied upon the inhabitants having right of common, a majority of whom, in value of property, should be authorised by law to impose it. In this way, the herbage produced would be of a better quality, and the health of the stock pastured upon it would be better preserved.

5. *Woods and Plantations.*—A great number of plants that may justly be denominated *weeds*, are to be met with in woods and plantations. As cattle or sheep are not usually admitted into these, until the trees are grown out of their reach, as in groves, it is of less consequence what plants

grow upon the surface; but if briars and brambles should appear they ought to be grubbed up, as making a plantation inaccessible even to its owner: and as ivy is injurious to the growth of timber, by confining and fretting the trees, and depriving them of the nourishment they would otherwise receive, it should be cleared away, before it has too long established itself; otherwise it becomes a kind of garment, the removing of which may chill, and in that way injure the tree.

6. *Gardens.*—A list of twenty-two plants has been given, to the growth of which gardens are liable. Several of them, like the couch, the common thistle, the common nettle, &c. are to be met with in the fields and hedges. Sometimes the seeds are wafted by the wind, and at other times introduced with the manure. Hence the advantage of using fermented dung, by which the vegetative power of seeds is destroyed. From the attention, however, paid to the garden culture, it is seldom that weeds are suffered to grow to any injurious excess.

2. *Instruments made use of in Weeding.*

There are several sorts of instruments used for that purpose, in particular, those for cutting weeds;—for pulling them up;—for digging them out;—also hand-hoes;—horse-hoes;—harrows;—and the scarifier, or grubber.

1. Thistles are sometimes cut by the sickle in corn crops, and by the scythe, or spud, in grass fields; but more generally by a simple instrument called the weed-hook, when the crops are growing.

2. In several instances, thistles among corn are pulled by the hand. Where this plan is adopted, the hand of the weeder is covered by a strong glove, which enables the person to take fast hold of the weed, and to pull it up.

3. Weeds are frequently rooted out by an instrument called the *docking-iron.* It consists of a forked, or clefted spike of iron, jagged within the cleft, and fixed to the end of a wooden lever; this being forced down by the hand or foot, so as to inclose the root of a dock or large thistle, will easily wrench it up, particularly after rain. In Buckinghamshire, *a small spade*, or *spud*, is made use of for this purpose, with which the best farmers are accustomed, to cut thistles in their pastures, under ground, twice a year ([381]).

4. Hand-hoes are of various sizes, suited to the work intended. In several parts of Essex, wheat is sometimes thrice

hand-hoed, which, if executed early, especially with a thin crop, is supposed to be beneficial ([382]). But where so great an expense must be incurred, drilling is to be preferred.

In Gloucestershire, hand-hoeing is still more prevalent. The plants of wheat are set out by the hoe, about six inches from each other, by which the heads are rendered larger and more productive. If any weeds, after all, make their appearance, they are destroyed by hand pulling ([383]).

In hand-hoeing drilled turnips, the tool is struck downwards, unless when the turnips are to be thinned, or set out, when the operator *shoves and pulls with it*, (as the operation is technically termed), that is, the hoe is alternately pushed across the drill, and drawn back, thus singling out the plants.

5. Horse-hoes are either what are called Dutch-hoes, (provincially *scrapers*), or small ploughs of the ordinary construction. In either case, the hoeing is executed by the aid of one horse; and skilful ploughmen are selected for conducting this important branch of rural labour.

6. The brake-harrow is a more effectual and expeditious mode of removing root-weeds than ploughing. The teeth should be 15 inches long, not sharp, but set obliquely forward. The land, if perfectly dry, should be rolled and harrowed alternately.

7. The scarifier or grubber, and a harrow invented by Finlayson, and greatly improved by Wilkie, are likewise most effectual implements for the extirpation of root-weeds. (See Chap. II. Sect. 7, No. 1, p. 116).

3. *The Expense of the Process.*

Considering the important advantages derived from weeding, the expenses cannot be accounted great; and they are always amply repaid, if the work be executed with judgment.

The expense of cutting weeds, or pulling them up by the hand, in crops of grain, must vary according to circumstances. Cutting thistles is often done at the rate of from sixpence to one shilling per acre, according to the number of plants with which the land is infested. Effectual hand-weeding will, in general, cost at least 10*s.* per statute acre, but in some cases more. The weeders begin as soon as the annual weeds will bear pulling; they sit, or rather kneel during the operation, as when weeding flax or carrots; and pull every weed that has made its appearance. This expense, however, is amply repaid, by the extra produce of the crop, and by the destruction of such a host of enemies, before they have done any injury to the crop. The expense of *hand-hoeing* crops of grain is very great. When thrice done, it has cost in Essex 31*s.* 6*d.* per acre ([384]).

The expense of weeding turnips by the hand-hoe varies. The first hoeing, being the most troublesome, will cost from 4*s.* to 5*s.* per acre: the second, about half that amount. In some cases, it is necessary to hoe turnips a third time, though the expense is then but trifling, seldom more than 1*s.* per acre. Total expense is about 8*s.* 6*d.* per acre. When beans and potatoes are hand-hoed, the soil not being equally well pulverized, the expense will be at least one-third more than that of turnips, or from 9*s.* to 12*s.* per acre.

The *scraper* will go over an English acre, at the expense of from 1*s.* 8*d.* to 2*s.* When the small plough is used, it will cost about 3*s.* 6*d.* per acre for turnips, and 4*s.* 6*d.* for beans and potatoes, each time that the land is hoed.

It must not be imagined, however, that the expense thus incurred, can be productive of no other advantage than that of cleansing the ground ([385]). In the month of June, these weeds are in their most succulent state; and if they are collected, and remain for a few hours to wither, cattle that are not pampered, will eat them greedily. Sheep also will eat charlock, and in the fens, if charlock appear among the coleseed, lambs are put in, to eat it off, when in blossom. There is scarcely indeed a hedge-border, or corner of a field, that is not at this season valuable, and whose produce might not be converted into valuable manure; yet in a few weeks, if the transient opportunity be not embraced, it may become a nuisance. The mode of converting weeds into a manure, by mixing them with earth, has been already mentioned, (see Sect. 5); but if that be considered a troublesome operation, they may be mixed with quick-lime, or at any rate collected and burned, when their ashes will be valuable.

4. *Means of preventing the Increase of Weeds.*

This is a point which requires a number of precautions on the part of the farmer. 1. There is a great risk of carrying a nuisance to his fields, if he use unfermented dung. 2. Great care should be taken, when corn is dressed, that none of the offal, which contains the seeds of weeds, should be thrown upon the dunghill. 3. Seed corn should be thoroughly cleansed from all other substances, before it is deposited in the ground; and, 4. Attentive farmers, will never purchase any seeds, but those of the cleanest and best sorts. Many fields, after being completely fallowed, and sown with grass-seeds with the fallow crop, have been found, when reploughed, to be stored with weeds of various sorts, most probably from some unfortunate mixture in the grass-seeds. The seeds of docks are often sown with clover, and those of other pernicious plants with rye-grass ([386]).

The seeds of weeds, are sometimes brought from the uplands in floods, floating on the water, and are left in multitudes by the eddies, along with mud, in particular places ([387]). These ought to be collected and destroyed.

5. *Regulations for the Destruction of Weeds.*

In several countries, the legislature has interposed its authority for the destruction of weeds. By a regulation in France, a farmer may sue his neighbour, who neglects to destroy the thistles upon his land at the proper seasons, or may employ people to do it at the other's expense ([388]). In Denmark, there is a law to oblige the farmers to root up the corn marigold *(chrysanthemum segetum)* ([389]). But the oldest regulation for that purpose, was probably in Scotland; a statute of Alexander II. about the year 1220, having been directed against that weed, which was considered to be peculiarly pernicious to corn-fields ([390]). Under the authority of that law, Sir William Grierson, a Scottish baron, was accustomed to hold *Goul* courts, for the express purpose of fining the farmers in whose growing crops, three heads or upwards of that weed were found ([391]). Such a plan, if generally adopted, would soon extirpate weeds; and as by a clause introduced into many leases, (and which ought to be universal), the landlord is empowered to cut down these weeds, at the expense of the tenant, if the latter neglect to do it himself; it is much to be regretted, that so useful a regulation should not be generally enforced.

The policy of some legislative provision for this purpose, has been frequently suggested. A clause enforcing the extirpation of weeds, in hedges, along the sides of roads, passed the House of Commons; but was thrown out by the Lords. It is to be hoped, that so useful a measure, even on a more extensive scale, will soon be passed into a law. By some it is recommended, that the destruction of weeds on the sides of roads, should be done at the parish expense [392]; by others, that it should be done by the road-surveyors, and the expense to be stated in their accounts [393]. The poor would be much more advantageously employed in this way, than in breaking stones.

6. *Advantages to be derived from the Destruction of Weeds.*

All plants which grow naturally, among a crop that has been sown, may be regarded as *weeds*, or, in other words, as enemies to the crop that is cultivated. The destruction of such plants, therefore, must be considered as one of the most important branches of the agricultural art; for if that is neglected, or even but slovenly performed, the crops may be reduced to the amount of one-fourth, or one-third of a fair average crop, even upon the very best soils. Besides, it merits consideration, that if weeds are suffered to exist, the full advantages of manuring land, and many other improvements, can only be partially obtained. Nor is this all; the mixture of weeds in the soil, prevents the crop from receiving the beneficial influence of the atmosphere;—sucks up that moisture so essential for the growth of the crop sown [394];—tends more than any other circumstance, to injure the crop when lodged by violent winds or heavy rains;—augments the risks at harvest, (for a crop that is clean, may be ready for the stack-yard in much less time than is required to harvest it, when encumbered with weeds);—and the seeds of these intruders, deteriorate the quality of the grain. Notwithstanding all the injuries thence sustained, how many are there, who hardly ever attempt to remove weeds in an effectual manner [395]. This negligence is the more to be blamed, because, were farmers at the trouble of collecting all sorts of weeds, before they have formed their seeds, and of mixing them with rich earth or lime, or fermenting them with dung, they would soon be reduced into a soft pulpy mass, and in this way, a pernicious nuisance might be converted into a valuable manure [396].

Various experiments have been tried, to ascertain *the positive advantage* derived from carefully weeding one part of a field, and leaving another part undone; among these, the following, made with peculiar accuracy, may be safely relied on.

1. *Wheat.*—Seven acres of light gravelly land were fallowed, and sown broad-cast; one acre was measured off, and not a weed was pulled out of it; the other six were carefully weeded. The unweeded acre produced 18 bushels;

the six weeded acres, 135 bushels, or $22\frac{1}{2}$ per acre, which is $4\frac{1}{2}$ bushels, or $\frac{1}{4}$ more produce in favour of weeding ([397]).

2. *Barley.*—A six acre field was sown with barley, in fine tilth, and well manured. The weeding, owing to a great abundance of charlock, cost 12*s.* per acre. The produce of an unweeded acre was only 13 bushels; of the weeded, 28. Difference in favour of weeding, 15 bushels per acre, besides the land being so much cleaner for succeeding crops.

3. *Oats.*—Six acres sown with oats; one acre ploughed but once, and unmanured, produced only 17 bushels. Other six acres ploughed three times, manured, *and weeded*, produced 37 bushels. This experiment proves, that oats require good management, and will pay for it as well as other crops ([398]). Ten bushels of the increased produce may be fairly attributed to the weeding; and the other ten to the manure.

The importance of weeding, both to the individual and to the public, is such, that it ought to be enforced by law. At any rate, a regulation of police, for fining those who harbour weeds, the seeds of which may be blown into their neighbour's ground, can have no injustice in principle. In England, the petty constable might be required, by precept from the high constable, to give in presentments to the Quarter-Sessions, containing a list of all persons who suffered weeds to run to seed in their hedges or lands, such presentments to be particularly specified to the court. Those referring to the coltsfoot, to be given in at the Lady-day sessions; and those referring to thistles, rag-weed, &c. to be given in at the Midsummer sessions. An order of court might then be made, for the immediate removal of such nuisances; and if not complied with, the offender should be fined a sum not exceeding five pounds, one half to the informer, and the other half to go for the relief of the poor ([399]).

If, in consequence of such a system being enforced, from four to five bushels of wheat;—fifteen bushels of barley;—and ten bushels of oats *additional*, were raised in all the
20 fields in the kingdom, whose crops are injured by weeds, the benefit would be well worth the labour and expense; and the farmers would soon find, that however anxious they may be, to have their lands *tithe-free*, yet to have them *weed-free*, is of still greater importance ([400]).

On the whole, keeping his land in a clean state, ought to be a principal object with every farmer; and if this be not carefully attended to, he may rest assured of paying dearly for his neglect. But the losses which he suffers, do not remedy the injury which the public sustains from his slovenly conduct. The regulations, therefore, which have been suggested, may be considered as both expedient and necessary; for were they adopted, it is evident, that many of the evils alluded to would be removed, and the wealth and agricultural resources of the nation materially augmented.

Sect. VIII.—*On Irrigation.*

Water is employed in various ways for the improvement of land. 1. By the process of what is strictly called *irrigation*, when water is made to trickle over the surface; 2. By *flooding*, when it covers the soil completely for a period of time; and, 3. By *warping*, when the water acts merely as a conductor of the *warp* or mud; by which the improvement is effected. We shall consider these several processes separately, beginning with irrigation.

This subject embraces the following particulars:—The objects to which irrigation is applied;—The methods of conducting the process;—The circumstances necessary to be considered previous to the plan being undertaken;—The waters best calculated for that purpose;—The proper soils and subsoils for irrigated meadows;—The effects of climate on irrigation;—The expense;—The profit;—The grasses best adapted for water-meadows;—The stock fed upon them;—The making and preserving water-meadow hay;—The objections which have been urged against irrigation;—The advantages attending it;—And the improvements of which it is susceptible.

1. *The Objects of Irrigation.*

It is generally supposed, that watering land is only calculated for the purpose of encouraging the production of grass; but irrigation is likewise applicable to the culture of grain, and has even been made use of for promoting the growth of timber.

1. *Grass.*—There are four modes by which water promotes the melioration of grass lands. It preserves a favourable degree of temperature;—improves the crop, by the nourishing substances it conveys;—destroys heaths and other

weeds, which delight in a dry soil;—and, as a mere element it is beneficial, more especially in dry seasons (401).

Water, as a carrier, likewise conveys other substances to the soil, by which it is enriched. This is, obviously, the case when land is irrigated by muddy waters, which leave behind them rich mould, and other substances. If lime or marl be held in solution, the waters become highly enriching. Other soluble and nutritive substances are also capable of being conveyed by water in the same manner, on passing through fertile tracts.

Meadow plants, cut green, without any external moisture on their stalks or leaves, and afterwards dried, lose by exsiccation, from 66 to 70 parts out of 100. This very large proportion of moisture, (though water is perhaps not the only substance carried off), is a direct proof, that water itself enters largely into the composition of these vegetables. Water is likewise of use, by the more equable diffusion of nutritive matter in the soil, which it necessarily occasions.

The system of watering land however, can never be carried to perfection, unless when accompanied by *drainage* and *inclosure*. Stagnant water, and impetuous torrents, do essential injury; but if water is entirely under command, so that it may be laid on, or taken off at pleasure, it may become a most useful instrument, in the hands of a skilful husbandman. Drainage is therefore a necessary preparation for irrigation (402).

With respect to inclosure, it can be of little real use to water lands, unless they are previously secured, by suitable fences, from poaching and trespass. Indeed these are necessary, not only for the advantage of the grass, but for the safety of the stock, as sheep cannot be suffered to resort to lands flooded in summer, from the risk of rot.

2. *Corn.*—In the East Indies, not only rice, but wheat and barley, are raised by means of irrigation; and it has long been a practice in some parts of Scotland, to enrich the soil for crops of grain, by the same means. Mr Scrymsoure of Tealing, a gentleman in Forfarshire, followed the practice for nearly fifty years, and with such success, that an inclosure, which had got into an exhausted state, was so enriched by it, that it preserved an uncommon degree of fertility for a succession of crops, (one of them wheat), without fallow, lime, or marl, and with very moderate assistance from dung (403). The common method was very different. After watering for one or two seasons, they ploughed for oats, and by taking two or three successive crops, the soil was

exhausted, and run out into weeds and poverty ([404]). Nothing else could be expected from such management. But in other parts of Scotland, irrigation was not only practised with considerable success ([405]), and for crops of grain, but immense quantities of wild oats, formerly prevalent, were completely extirpated, and for the destruction of which no other means were known, previous to the introduction of fallowing and of green crops ([406]). Water alone, however, without the addition of other substances, will not bring grain to perfection. Hence, though from year to year, it may be applied to meadow and pasture grass with success, yet it cannot be repeated with advantage *to corn*, except at considerable intervals of time, or accompanied with manure ([407]).

The system of irrigating for corn, seems likewise to have succeeded in Somersetshire, where a large tract of country, suffered to remain in pasture for two years, was, during that time, at stated intervals, regularly flooded by a stream descending from the adjacent hills. It was then subjected to the following rotation of crops: 1. Wheat on the ley; 2. Turnips; and, 3. Barley, with artificial grasses. The produce of grain was very considerable, namely, of wheat, from 40 to 50 bushels, and of barley, from 50 to 60 bushels per statute acre ([408]). In a late publication on the utility of water-meadows, a question therefore is not improperly put, whether, upon particular soils, and under certain circumstances, irrigation might not produce similar effects upon wheat, and several other plants of the field and the garden, as upon herbage? The author adds, that no good reason can be assigned, why this valuable improvement should be restricted to the cultivation of grasses ([409]).

3. *Plantations.*—It is recorded in the Statistical Account of Scotland, that irrigation was in one instance used for a very singular purpose. Captain Shand of Templand, in Aberdeenshire, conducted water through his young plantations, and found, that when done with judgment, it was the cheapest and most effectual mode of encouraging the growth of trees ([410]). To the alder, the willow, and even the birch and the ash, it may be of use; but unless in very dry soils, it must be dangerous to forest trees.

On the whole, the improvement of grass, seems to be the great object to which the watering of land is peculiarly applicable.

2. *The Methods of conducting the Process.*

Water meadows are of two sorts; *flowing*, calculated for a flat country; and *catch-work*, for sloping grounds.

Flowing Meadows.—Where the ground is flat, the soil is formed into *beds*, or broad ridges, like those met with at bleachfields. They are commonly from 30 to 40 feet wide, and nine or ten poles in length; as, in such situations, the great object is, to be able to carry off the water quickly, when once brought on. Hence it is necessary to throw up the land into high ridges, with drains between them. More of the failures in irrigation arise, from the ridges not being sufficiently high, and the slopes not being sufficiently steep, than from any other cause ([411]).

Catch-work Meadows.—It is difficult to give an intelligible written description of the mode of making these meadows. To be properly understood, the operation must be seen. It may, however, in general be remarked, that the system is calculated for sloping grounds; and that, after the water is brought from the original stream into a new cut, it is stopped at the end, on as high a level as the case admits of, by which the water is made to fill the trench, and run over at the side, so as to flood the land below it. But as the water would soon cease to run equally, and would wash the land out in gutters, it has been found necessary, to cut small parallel trenches, at the distance of from 20 to 30 feet, to *catch* the water again (whence the name originated), and the same plan of spreading, or diffusing, is continued, until the water reaches the main drain at the bottom of the meadow ([412]). A great advantage attending the catch-work system is, that it is not only less expensive, but the same quantity of water will do much more work.

In either of these ways, irrigation promotes the growth of grass. The herbage of dry land is impoverished from the want of water; that of wet land, by its remaining stagnant; but both these evils are remedied by the processes above described.

3. *Circumstances to be considered, previous to the Plan being undertaken.*

The first point to be ascertained is, whether there be a sufficient quantity of water at command. For want of due attention to this important circumstance, mistakes have sometimes been made, both in England and Scotland, extremely prejudicial to the advancement of irrigation.

The next objects are, the quality of the water, and the nature of the soil and subsoil of the land proposed to be irrigated.

It is then proper to consider, *how*, and *where*, the water can be taken out of the stream. This can only be done by a proper level; and the assistance of a professed irrigator will be necessary.

Irrigation being an operation requiring considerable nicety and skill, cannot be advantageously conducted, without attentive hands to form the soil, to lay on and shift the water, and to remove it; also to cut down the produce, and to make it into hay. On all these accounts, a supply of trusty labourers, for carrying on these several processes, must be provided [413].

Nor is this all. It is likewise necessary to ascertain, whether there are any obstacles to the proposed improvement, arising from the claims of millers, or canal owners [414], (which are often great impediments), the intervention of other property, or from leases granted to the farmers on the estate. The command of capital adequate to the expense likely to be incurred, is absolutely necessary.

4. *Of the Water calculated for Irrigation.*

Clear spring-water, in the state in which it issues from the hills, (more especially where the strata are calcareous), is certainly of a fertilizing quality. It is charged with a considerable quantity of vital air; near the source also, it is usually warmer than other waters, and thence it answers better for irrigation, more especially during severe weather in winter. From these properties, there is always produced abundance of early succulent grass, for several yards where the water first runs over the land near the spring. Clear spring-water may also be used longer than foul or muddy water, it being less apt to render the grass gritty and unwholesome; hence some give a decided preference to clean-watered crops [415]. The water of petrifying springs is likewise highly fertilizing.

Mountain streamlets, fed principally by springs, are more at command than rivers, more convenient to be directed over slopes, and also better calculated for improving grass.

Where river-water is accessible, it is commonly loaded with many enriching substances from the country, and the towns and villages through which it passes; and is thus productive, not only of temporary, but of permanent improvement.

Sea-water also, where it can be employed for that purpose in moderate quantities, or made use of within embanked marshes, is applicable to the purposes of irrigation. It contains, more especially near the land, not only animal and vegetable substances, but also saline mixtures in solution. The utility of salt marshes to diseased horses, and their acting as a restorative to sheep in danger of, or infected by, that fatal malady the rot, is well known. These ideas are corroborated by an observation, that the meadows near the mouth of the Severn, *where salt water is spread over the lands by the tide*, are grazed, instead of being mown, and are accounted the best possible pasture for horses and cattle that require rest and spring physic ([416]).

In regard to waters much impregnated with iron, they were formerly supposed totally unfit for the purposes of irrigation; but it is now fully proved, by the accurate experiments of an able chemist, and by the extraordinary growth of grasses in Prisley meadow, in Bedfordshire, that ferruginous waters are friendly to vegetation, when properly applied ([417]). Springs, however, or water impregnated with other mineral substances, as lead or copper, never do good; and it is well known, that waters of that description, after they have been brought into fields, by levels cut at a considerable expense, have again been diverted, and suffered to flow in their original channels ([418]).

Waters that are impregnated with the juices that flow from peat-mosses, are considered by many, not worth applying to the soil ([419]). It is objected to them, that they are soon frozen;—that they convey no material nutriment;—and that they are commonly loaded with such antiseptic substances as will retard, instead of promoting vegetation ([420]). It is urged, on the other hand, that a want of sufficient slope in the meadow, or of proper management in regard to the water, may have occasioned the disappointments experienced in some cases, when bog-waters have been applied ([421]).

5. *Of the Soil and Subsoil.*

Irrigation is not restricted to any particular description of soil. Land naturally wet, may be greatly improved by it, when accompanied by drainage; and it is equally beneficial to that which is dry ([422]).

Rich loams produce the largest crops, even though the waters be not of the first quality. Peat-bogs, when properly drained, will likewise yield good crops [423]. Irrigating adhesive clays is expensive, and the beneficial effects from it do not soon appear; but it is evident, from a meadow near Longleat, that even this sort of land may, by good management, be thus rendered more fertile; and it is well known, that some of the best meadows in Gloucestershire, and at Woburn, are upon a clayey substratum [424].

Barren slopes may be advantageously improved under the catch-work system; and in this way, much land, at present covered with heath, furze, or broom, may be rendered productive of hay, or valuable grasses. The most suitable soils, however, are those of a sandy or gravelly nature; more especially when they can be irrigated by muddy streams, the sediment of which corrects their excessive openness. Indeed, by means of the warm and rich waters, of a low, fertile, and populous district, impregnated with mud, and containing animal and vegetable manures, almost any soil may be converted into a rich meadow.

The bottom or subsoil of a water-meadow, is of more consequence than even the quality or depth of the soil. A loose gravel, or bed of broken flint, with little or no intermixture of earth, where that can be obtained, is the most desirable subsoil. With such a bottom, in seasons when water is abundant, a soil, not six inches in depth, is quite sufficient to produce large crops.

Effect of Climate.—The process of irrigation, seems to be attended with much more beneficial effects, in warm, than in cold climates. The difference of the seasons between Gloucestershire, in England, and Aberdeenshire, in Scotland, produces very important consequences. The latter is usually about five weeks more backward than the former: hence, it is hardly possible, to get such early crops of spring grass, in the districts of Scotland, as are easily to be obtained in England; and thus one of the principal objects of irrigation, (feeding ewes and lambs in spring), is thought to be unattainable. Nor will the application of water produce two, much less three crops of hay in Scotland, as it does in North America. The advantages of water-meadows, however, are important, independent of spring feed; more especially when the catch-work system can be adopted, as the expense of that process is inconsiderable.

6. *The Expense.*

This varies according to the nature of the work. Where the catch-work system is practicable, in favourable situations, the forming may be done as low as 10*s*. per acre. This fact is, in many cases, decisively in favour of this natural and simple mode, which requires also much less water, and often answers fully as well as flat flooding ([425]).

The expense of *bed-work*, as it is called, is, however, considerable. If the ground to be flooded, be smooth on its surface, or in regular ridges, and if the water can easily be brought to the meadow, with a temporary weir, supposing the extent to be almost 20 acres, it may be done at from L.5 to L.10 per acre; but if the land be of large extent, with an irregular surface; if a large conductor, and a proper weir shall be required, with hatches both in it, and also in the feeders; and if the aid of a professional person, to lay out and oversee the work, be necessary, (which is generally the case), the expense will vary from L.10 to L.20 per acre ([426]). Nay, in Wiltshire, where they are anxious to have their meadows formed in the most perfect manner, with that regularity which the nice adjustment of water demands, the expense per acre has amounted to forty pounds ([427]).

7. *The Profit.*

The profit resulting from this operation, when properly conducted, is always considerable. Mr Wilkinson proves, by authentic documents, that all the outgoings, both capital and interest, were refunded within two years, besides a very considerable permanent increase in the value of the land ([428]). Mr Eyres derived great advantage from his meadow, even the first season, by pasturing on it sheep, cattle, and even cart-horses ([429]). Mr Clough found that land, which, before irrigation was applied to it, was not worth more than six shillings per acre, was thereby increased in value to L. 2, 15s. per acre, even to a farmer; and if let to the inhabitants of a market-town in the neighbourhood, would fetch L. 3, 10s. if not more ([430]).

The following is the statement of profit from the formation of an irrigated meadow, on the estate of the late Mr Ferguson of Pitfour, in Scotland, who carried on that species of improvement with much energy and success.

	£.	s.	d.
1. Interest, at 7½ per cent. on the original expense of making, L.10, on an average per Scotch acre,	0	15	0
2. The old rent of the land,	0	10	0
3. The annual expense,	0	8	0
	£. 1	13	0

The annual value being raised to L.4 per acre, hence it is calculated, that there is a clear annual profit of L. 2, 7s. per acre [431].

A very distinct account of the expense and profit of a water-meadow, is given in the Hampshire Report. The produce is stated at L.9 : 3 : 4 per annum, without including the advantage of folding the sheep from the meadow, on tillage or other uplands, which is estimated to be worth 16s. 8d. more, or in all L.10. The expenses, including the interest of the money expended in forming the meadow, amount to L.5 : 18 : 6; leaving a balance of L.4 : 1 : 6 in favour of the meadow.

It is, however, contended, that neither the grass, nor the hay, produced by irrigation, contains those feeding or fattening qualities which are found in upland herbage. The stock will "hold their own," or keep to the state in which they were, when put to such food; they will increase in size, but not in condition. Others will not admit to its full extent, the truth of that doctrine; and besides maintain, that the benefits resulting from irrigation, are sufficiently ample, to support the practice, even though its produce may not possess a feeding or grazing quality [432]. Nor is the pecuniary profit arising from irrigation, so material, as those indirect or secondary advantages resulting from the system, which shall afterwards be detailed.

8. *The Grasses best adapted for Water-Meadows.*

Where the catch-work system is adopted, the surface of the meadow is rarely much broken; the natural grasses in the ground are trusted to, and it is seldom necessary to procure any seeds, except for bare or vacant spots. When ridges, however, are formed by the spade or the plough, they are generally destitute of grass when first laid down. It is necessary, therefore, to sow the seeds of such plants as are best calculated to produce valuable and abundant crops. The most useful are, 1. *Perennial red clover*, cow, or marl grass, *(trifolium medium)*; 2. The rough-stalked meadow-grass, *(poa trivialis)*; and, 3. The crested dog's-tail, *(cynosurus cristatus)*. Timothy, *(phleum pratense)*, is greatly preferred for water-meadows in America; and, in boggy lands, fiorin, *(agrostis stolonifera)*, is found peculiarly productive in that species of soil. Where the object is pasture, rather than hay, white clover, rye-grass, and the meadow foxtail ought not to be omitted. The soil of itself, when watered, will produce grasses the most congenial to the state of the land, and the degree of moisture applied to it; but a little manure, at the commencement of irrigation, by beds, (unless the turf has been pared, and preserved to be put upon the surface), is thought by some advisable. In short, the superior grasses in general will thrive under irrigation.

9. *The Stock to be fed on Water-Meadows.*

The advantage which a sheep farmer derives, when the climate will admit of it, by feeding his ewes and lambs *in spring*, ([433]), on a watered meadow, can hardly be sufficiently estimated ([434]). At that pinching period of the year, food is always scarce; and lambs, once checked in their growth, cannot afterwards be fattened. There is an interregnum, (if the expression may be used), between the vegetation of one year, and that of another, which is best supplied by an early crop of grass. Where this expedient is not resorted to, or where Swedish turnips, cole, or savoys, (kail), are not extensively cultivated, the farmer may have no succulent food to give his flocks, and will of course suffer severely. During spring, Bakewell recommends, that no heavier stock than sheep, or calves, should be admitted on the meadow. Much, however, depends, upon the quality of the soil and subsoil, for where either consists of gravel, a farmer can feed his milch-cows during the spring, and after making a considerable quantity of cheese, may obtain three tons of hay per acre ([435]). In Wiltshire, after a crop of hay is taken, it is not usual to attempt a second, unless hay is very scarce; for the grass being of a soft nature, it takes so much time to dry, that it can seldom be well made into hay: and it is of much greater value when fed with dairy cows, which may remain on the meadows, till the flooder begins to prepare for the winter watering ([436]). In autumn, fatting beasts, and even cart-horses, have been put on a water-meadow ([437]).

10. *On Water-Meadow Hay.*

As the grass of water-meadows is frequently large and coarse in its nature, it is advisable to cut it young; and then, if it be well made, the hay is of a nourishing and milky quality, either for ewes or dairy cows. It has likewise been given to horses, and when properly made, they thrive upon it (438).

It is proper, however, to observe, that from the great succulence of the herbage, the making of water-meadow hay, requires a very considerable degree of attention (439); and that when the grass from which it is made, has been over-watered, or rendered impure by scum or mud; or when the hay has been ill made in the meadow, or injured in the stacks, it will be hurtful to any stock to which it is given: but that altogether originates from mismanagement; and it has been found by experience, that cows, if they do not fatten so well, yet give much more milk from hay produced by irrigation, if cut early, and having much more softness and succulency, than any hay produced from grass-lands, that have not been irrigated (440).

11. *Objections urged against Irrigation.*

Some have asserted, that water-meadows render a country unhealthy, by making the water stagnant; but no opinion can be more erroneous. In fact, where meadows are irrigated, the water must constantly be passing over the surface, with a brisk current, and always kept in motion, to be of any service. Many of the best meadows also, in their original state, were unwholesome morasses, the draining of which, has essentially contributed to the salubrity of the air (441).

Others think, that though the produce may be increased, it becomes in a few years of so coarse a nature, being mixed with rushes and coarse plants, that cattle frequently refuse to eat it, and that the appearance of cattle so fed proclaims, that it is far from being of a nutritious quality (442). But this objection is never applicable to meadows skilfully made, and properly managed; and whenever the grasses are coarse, they should be cut earlier, if intended for hay. The growth of rushes and water plants is a proof, that the meadow lies too flat, and is ill managed.

12. *Advantages of Irrigation.*

Where the situation is favourable, the following benefits result from the practice of irrigation. 1. With the exception of *warping*, it is by far the easiest, cheapest, and most certain mode of improving poor land, especially if it be of a dry and gravelly nature. 2. Land, when once improved by irrigation, is put in a state of *perpetual fertility,* without any occasion for manure, or trouble of weeding ([443]), or any other material expense. 3. It becomes so productive, as to yield the largest bulk of hay, besides abundance of the very best support for ewes and lambs in the spring, and for cows and other cattle in the autumn of every year. 4. In favourable situations, it produces very early grass in the spring, which is doubly valuable; and, 5. Not only is the land thus rendered fertile, without having any occasion for manure, but it produces food for animals, which is converted into manure to be used *on other lands,* thus augmenting, in a compound proportion, that great source of fertility ([444]).

Were these advantages more generally known, or more fully appreciated, a large proportion of the kingdom might become like South Cerney, in Gloucestershire, where every spring, or rivulet, however insignificant, is made subservient to the purpose of irrigation, fertilizing, in proportion to its size, either a small quantity, or a large tract of land ([445]).

13. *Improvements suggested in the Practice of Irrigation.*

In some recent publications on the subject of irrigation, hints are suggested, for the farther extention and improvement of that operation.

The first is, that of watering land by machinery. If the land be put in a proper form for irrigation, and supplied with a good stream, at proper seasons, no difference can result from the method of getting it on the surface; and if all other circumstances are equally favourable, the same fertility may be expected from water thrown up by a drain mill, as that which runs from a brook ([446]). A cheap and effectual power for raising water in sufficient quantities, to flow about ten acres at a time, would be an invaluable acquisition; for a productive water-meadow, is probably the true mark of perfection, in the management of a farm ([447]).

The other suggestion is, that of employing machinery to raise not only fresh, but even sea-water, for irrigation ([448]). It is well known, how much all kinds of stock are improved by salt marshes, and how beneficial to them is a moderate quantity of saline matter. There are many parts of the kingdom, where, by the aid of machinery, these advantages might be obtained at no great expense ([449]).

Sect. IX.—*On Flooding Land.*

The mode of improving land by "*Flooding*" is, to cover it for a time, or *drown* it by a quantity of water from a stream or lake; by means of which, (if it takes place in a favourable season), the future production of crops, both of grass and of grain, is promoted. It differs completely from irrigation, in which the water ought constantly to be in a *flowing state*, whereas in the process of artificial flooding, it is wholly or nearly *stagnant*. The great object of the process is, 1. To admit the water, without any injury to the surface of the soil from the force of the stream; and, 2. To withdraw it in such a soft and regular manner, that none of the mud, deposited on the surface, shall be taken away.

Along the margins of many of the rivers in England and Scotland, the meadows are thus improved: When the floods take place in winter or spring, they produce the most fertilizing effects; but these flat grounds, being rarely protected by embankments, often suffer severely from overflowings in summer and autumn. The management of these meadows on improved principles, shall be discussed in a subsequent section. (Chap. IV. Sect. 3.)

The most striking instance known in Great Britain, of advantage being derived from the inundations of a lake, is that of *Loch Ken*, in the stewartry of Kirkcudbright. At the head of that beautiful piece of water, there is a flat of about 240 statute acres, which is rendered, by flooding, one of the richest spots in Scotland. Many acres in it produce at the rate of three tons of hay each, and some parts of it have been cropped with grain for 25 years in succession, without any manure, except what it receives from the inundations, which leave behind them a variety of enriching substances ([450]).

The advantages of *flooding*, in favourable circumstances, cannot therefore be too highly appreciated; and it evidently appears that water, in a *stagnant state*, may produce the most beneficial effects, more especially where the surface is incumbent upon an open subsoil or bottom.

From the advantageous consequences of flooding, when done by nature, there is reason to imagine, that the same benefit would result from it, when artificially executed; and this was formerly attempted in various parts of the kingdom. Hence the obsolete practice of *floating upwards*, as it was termed, which in fact was a species of warping. For that purpose, the water was penned, in times of floods, by means of a dam or flood-gate across the bottom of the meadow, or flat to be watered. The waters were not suffered to remain long upon the land, but were let off as soon as it was judged that they had deposited their sediment (451). The benefit arising from this method of using flood waters, it is said, was considerable; but when the improved mode of irrigation, by floating ridges, was introduced, and found more advantageous, the other was discontinued (452).

Besides these meadows, mill-ponds thus fertilized, were rendered dry, and cropped with oats; artificial pieces of water were likewise filled up, and became productive; and by means of sluices, and other contrivances, low grounds and bogs were laid under water during the winter months, and greatly enriched with productive vegetable earth, from the surface of the higher parts. The waters were let off in spring, and the ground was then ploughed and sown (453). But in consequence of the great humidity of the soil, the crops were very late, and in a wet summer, they were lodged and spoiled. In dry seasons, however, and where proper attention was paid to the draining and ridging of the soil, the returns were considerable, and the land was enabled, without manure, to raise good crops of grain (454).

In discussing this mode of reclaiming waste land, it is proposed to consider the following particulars: The manner in which the plan ought to be carried into effect;—The mode in which the flooding operates;—The kinds of water either proper or improper for the purpose;—The seasons fittest for the operation;—and, The advantages and disadvantages attending it (455).

1. *Manner of carrying the Plan into effect.*—This plan of improvement, is only calculated for tracts, where there is a command of water, and an opportunity of stemming it up, so as to overflow the whole surface. In many places, there are such situations, in particular all land-locked peat-mosses, that lie on a level lower than the adjacent springs or rivers. In some districts, 200, 300, and even 400 acres of mossy land, may be laid under water, by raising a single bank at the outlet, which may be effected at a trifling expense. Merely by shutting up such openings, and stemming the streams that flow through them, this species of improvement can be *artificially* accomplished.

2. *Mode in which the Flooding operates.*—Some ingenious reasons have been assigned, for the advantages resulting from this process: as,—that it promotes the fermentation of

any vegetable matter with which it comes in contact;—and that the mechanical weight of a body of stagnant water, must tend to consolidate, and to improve the texture of a soft soil. But the salutary effects of flooding, may principally be ascribed to the advantages of moisture, so essential for vegetation; and to the particles of sand, clay, earth, calcareous matter, and other adventitious substances, with which the waters are impregnated. In peat-bogs also, flooding has a powerful effect, in decomposing and extracting the antiseptic substances, or colouring matter contained in the bog, and carrying them off.

3. *The Waters calculated for Flooding.*—All sorts of water are not equally adapted for the beneficial practice of flooding. Pure spring water, especially such as issues from calcareous strata, answers the purpose well; and if it can be used in sufficient quantities, will convert heath and coarse herbage into sweet pasture grasses. Soft, and also muddy water may be employed with advantage. River water is often impregnated with a number of useful ingredients; and the quality of water may sometimes be artificially improved, by a mixture of calcareous and other substances. But waters that issue from peat-mosses, or soils impregnated with pyrites, or bituminous oil, are considered to be injurious.

4. *The Seasons fittest for the Operation.*—The object of water meadows, is essentially different from that of improving waste lands by means of flooding. In the former case, water is frequently made use of to nourish the grasses already produced by the soil. In the latter the purpose is, to destroy the indigenous plants, as they are generally useless. Hence, though covering the soil with water *in winter*, is of use, yet the greatest improvement must be effected by *summer flooding*. *The heat of the sun*, combined with water, produces a putrid fermentation of the vegetable matter on the surface of the land; after which, when the land is left dry, the coarse and useless herbage disappears, and a rapid growth of succulent grasses rises in its place. This is the result even on sterile mosses.

5. *Advantages and Disadvantages of the process.*—The great advantages of *flooding* are, the cheapness of the process, and the facility with which it is executed. On the other hand, it is only in very flat countries that it can be used to any extent; and if it be carried on upon a great scale, covering great tracts of country with water, in cold, and still more in the warm seasons of the year, must render the climate moist and unwholesome ([456]). At the same time, where the

situation is favourable, it can hardly fail to be attended with benefit, in a pecuniary point of view; and of all the methods of reclaiming waste land, flooding is one of the most expeditious and the least expensive.

The practice of flooding, under the name of "*The Loch Husbandry*," has been carried to great perfection in Livonia. It has there been ascertained, that it is a great improvement to have fish put into the water employed in flooding the soil. Carp is principally employed, at the rate of from thirty to forty fish per acre. They are put in at from six to eight months old, and it is found, from the fertility they produce, that the land will yield a third more in this way, than if the water had been without fish. The family of a great landed proprietor in Courland, (Baron Hoher,) owes its fortune entirely to this system. They have twelve fields appropriated for the purpose of flooding, four of which are constantly under water, and the other eight fields were cropped with grain, by means of which, an immense quantity of straw is annually furnished. This is an important acquisition in a country, where they are obliged to keep their cattle constantly shut up in cow-houses, for five or six months in the year ([457]).

Sect. X.—*On Warping Land.*

There is no circumstance which proves more clearly the advantages to be derived from minute and extensive inquiries, adopting for their basis the political divisions of the country ([458]), than the discovery of the process called *warping land.* This most valuable species of improvement, applicable wherever tides in their course keep alluvial matters in a state of suspension, was confined to a small district on the banks of the Humber; and though it had existed there for about 50 years, yet not a syllable concerning it, had ever found its way into a page of printed husbandry; and it might have remained unknown for many years longer, had not the Board of Agriculture undertaken the survey of the kingdom, in the course of which it was brought to light ([459]).

In discussing this subject, it is proper to consider,—The origin of the practice;—The nature of the improvement;—The means of effecting it;—The season most suitable for the purpose;—The expense and profit;—The mode of cultivation and produce;—The situations where it may be attempted;—and, The improvements and the extent of which it is susceptible; together with some account of a species of river warping in Italy.

1. *Origin of the Practice.*—A species of warping has been long known in Italy (460); but the person who made the first experiment of warping in England, was Mr Richard Jennings of Armin, near Howden in Yorkshire, who tried it about the year 1743 (461). It was about the year 1753, before it was attempted by any other person; and it remained in obscurity, till the beginning of November 1793, when it was made public by three eminent farmers, who had been appointed by the Board of Agriculture, to draw up a report of the husbandry of the West Riding of Yorkshire (462). As the Board had only met for the first time, on the 4th day of September preceding, the discovery of warping, in less than two months, is a striking proof of the zeal and activity of those appointed to carry on its inquiries.

2. *The Nature of the Improvement.*—The water of the tides that come up the Trent, the Ouze, the Dun, and other rivers which empty themselves into the great estuary of the Humber, is muddy to an excess; insomuch, that in summer, if a cylindrical glass, from twelve to fifteen inches long, be filled with that water when the tide is high, it will presently deposite an inch, and sometimes more, of what is called *warp*, or a species of mud of great fertility. This substance probably originates from a variety of earthy particles, washed down by the rivers to their mouths, where they are mixed with saline and other fertilizing matters with which the sea abounds, and by agitation are rendered so fine, as to be suspended, when the water is agitated by the tide. Some of it was analysed by an eminent chemist, whose report was, that it contained mucilage, and a very minute portion of saline matter; a considerable quantity of calcareous and most probably aluminous earths; the residue mica and sand; the latter in by far the larger quantity, but both in very fine particles (463).

3. *Mode of carrying the Plan into effect.*—The plan of securing rich alluvial soil by embankments, has been practised for ages; but it was reserved for modern times, to conduct mud-laden waters, *artificially*, from the estuary or river in which they flowed, for the purpose of furnishing low and barren ground with a sufficient depth of fertile soil (464). The mode of executing the plan is extremely simple. When the improvement is determined on, the ground must first be surrounded with banks from three to four, six, or seven feet high, according to circumstances, that the water may be of a proper depth on the land to be warped, and to prevent

the contiguous lands, whether cultivated or not, from being overflowed. The tide is then admitted, and detained, until the sediment in the water is deposited, upon the surface of the land. To render the plan efficacious, there must be a complete power over the water, either to keep it out, or to let it in, according to circumstances; and to accomplish these objects, there must be, not only a cut or canal made to join the river, but a sluice, (provincially *clough*), to open or shut, as required. The effect is very different from that of irrigation, for it is not the water that produces the effect, but the warp or mud; and the great object is, not to manure, *but to create a soil* of the richest quality, and that at a moderate expense ([465]).

4. *The Season for Warping.*—June, July, and August are undoubtedly the best months for warping, on account of their being in general the driest seasons of the year. Land, however, may be warped in any season, provided the weather be dry, and the fresh water in the river very low. When the season is wet, and the river full of fresh water, this operation cannot be advantageously executed. The fresh water, in this case, stems the tide, and occasions a degree of stagnation, favourable to the repose of the prepared matter, and consequently it is not half so muddy, nor capable of depositing the same quantity of sediment, as when the tide flows in more freely, and stirs up the mud. Warping, in spring, is attended with no peculiar advantage, more than in summer, as there can be no crop the first year. The sediment must lie to soak and dry, before the ground can be cultivated ([466]).

5. *The Expense and Profit.*—Without ascertaining the situation of the lands proposed to be warped, it is impossible to calculate the sum it will require to embank the lands, to build the *cloughs* or sluices, to cut the drains, &c., and the quantity of land the same drains and cloughs will be sufficient to warp; for the greater the quantity, the less will be the expense per acre. There are *great quantities* of land, however, which might be warped, for so small a sum as from L.3 to L.4 per acre; an expense trifling, when compared to the profit that is derived from the operation. Mr Webster, at Bankside, in Yorkshire, purchased a farm of 212 acres, which he warped. The price was L.11 per acre, and the expense of warping about L.12 more, or L.23 in all. It was immediately rendered by warping worth L.70, and in some parts, even L.100 per acre, at which price warped land frequently sells: but even at L.70 the

profit is immense. Mr Webster warped some moor-land, worth only 1s. 6d. per acre, (for such land there is in that neighbourhood), and could immediately let it for L.5 per acre.

6. *The Mode of Cultivation and Produce.*—The best mode of cultivating new warped land, is to sow it with clover, and to let it remain under that crop for two years, in order that it may be brought into a state fit for corn. It does not answer to sow land, immediately after it is warped, with wheat, even though fallowed; but after white, or red clover, continued for two years, a good crop of wheat may be relied on, unless injured by the slug, which sometimes makes its appearance ([467]).

Nor is it proper, when land is warped, to plant it with potatoes, or to sow it with flax, it being at first of too cold a nature; though these crops may answer, if the land be not too strong for potatoes, after it has been for two or three years in cultivation.

In the quality of warped land, there are most essential differences; some parts of the field being very strong, and others very friable. The land nearest the drain is in general the lightest, owing to the quantity of sand that is deposited as soon as the water enters the field: the land farthest from the drain is, in general, the best. The produce of warped land varies much; but in general, it may be stated, of wheat, at from 20 to 40 bushels; of beans from 35 to 50, and in some rare instances even 80 bushels; and of oats from five to eight quarters per acre. Warped lands require manure, and will not carry many crops without its aid, even where the situation is dry, and the soil fertile ([468]).

7. *Can the Process be extended?*—Some doubts are entertained, whether this great repository of highly prepared matter in the Humber, may not be exhausted ([469]). But there seems no just ground for such apprehension, when the great extent of the estuary in which it is found, and the vast tract of country, which, for ages, has been pouring down these valuable substances into its bosom, are considered. At the same time, it would be desirable to remove every doubt of that sort, by as accurate examinations of the banks or the bed of the river and the shoals in it, as is practicable in such cases. If upon inquiry it should be ascertained that the quantity of warp is as immense, as there is reason to expect, it is to be hoped, that such a treasure, in value equalling any of which the country is possessed, will not be neglected. We have the means in our power, of converting land worth only a few pence, to land worth L.5 per acre per

annum; or in other words, of transmuting *copper into gold.* The efforts made in Egypt to obtain, and to secure the fertility of its soil, in circumstances not very dissimilar, are well known; and shall nothing be done by the British Government, to promote an imitation of the husbandry of the Nile, on the banks of the Humber, and of other rivers where it may be found practicable? Why not give some species of public encouragement to so great a national object [470]? more especially as the valuable substance in question, (silt or warp), is not confined to the Humber, but is to be met with, in great perfection and abundance, in many of our other rivers and arms of the sea.

8. *Of River Warping in Italy.*—From some late accounts which have been published, of the agriculture and statistics of Italy, it appears, that a species of warping has been long known in Tuscany. It is there called *colmata.* The rivers in that country carry down with them vast quantities of mud and sand, by which their discharge into the sea is impeded, and great marshes are formed, not only at the mouths of these rivers, but in their courses, when they are passing from one level to another. Torricelli, it is said, was the first who taught his countrymen to inclose the marsh with a dike or embankment;—to admit, into this inclosure, the water of the rivers;—to force this water, by means of sluices, to remain stagnant as in a lake, so as to deposit its mud;—and by the sediment so produced, to raise the level of the bottom. At one time, three or four inches of earth have been often deposited;—the operation has been several times repeated in the course of a year;—and the level so much raised, that the ground is no longer liable to be overflowed by the river. The soil thus acquired, is of the highest fertility; and an instance is mentioned, of a piece of ground thus treated, which had yielded 25 measures of wheat from one [471]. Necessity was the parent of this operation in Italy; whereas, on the banks of the Humber, it seems to have originated from accident, and has been carried on, by a zeal for improvement, and the prospect of gain.

Sect. XI.—*On Embankments.*

The nature and advantages of embanking are twofold; 1. To protect land, already under profitable production, from the encroachment of the sea, of fresh-water lakes, or of rivers, which often inundate the low grounds in their neighbourhood; and, 2. To reclaim from the sea, or large rivers, land overflowed by them, and to render it useful territory.

1. *Protecting Lands from Inundations.*

This is a subject of considerable extent and importance. In many districts, the sea makes perpetual inroads on the land; in others, lakes, during the rainy seasons of the year, or after the melting of snow, spread their waters over the adjacent flat land; while, above all, there is scarcely a river in the country, that does not, every season, commit devastations along its banks, either rendering large tracts unproductive, or destroying and sweeping away the harvests.

1. *Protection against the Sea.*—Where the coast is defended by bulwarks, consisting of loose, soft, and penetrable materials, they are often broken down by the sea, more especially in high tides. The extent of land on the coast is thus proportionably diminished, and considerable injury sustained. Bulwarks for preventing such encroachments are, in most cases, both difficult, and expensive in the execution, and often precarious in point of permanency. The power of water, when impelled by strong wind, is not easily resisted; and when the sea is to be contended with, the barriers erected against it, ought to be constructed with peculiar care, as many circumstances may occur, to obstruct their execution, and to overturn them when supposed to be completely finished ([472]).

To prevent this mischief, artificial barriers of stone, or of wood and stone, should be erected, to stop the progress of encroachment; but sometimes banks of shingles, and even of sand, found on the spot, have answered, by an attentive imitation of nature, in the formation of shoals, and ridges of the beach ([473]). Where the object is, to protect such low parts of the coast as are subjected to inundation, by the flowing of high tides, a regular bank should be formed, the breadth, height and strength of which, should be proportioned to the depth and weight of water it may have to resist. As a farther security, piles should be driven into the shore, in front of the bank, to break the force of the waves. By this expedient, the walls receive no farther injury, as the space between the piles and the bank, is, in this manner, rendered tolerably smooth, however tempestuous the waves may be without ([474]).

2. *Protection against Lakes.*—In general, lakes are sub-

ject to temporary and extraordinary swells, occasioned by violent winds, great falls of rain, or the melting of snow; consequently, they often spread beyond their usual limits, overflowing and injuring the neighbouring land. The effects are so injurious, as to make it an object of importance to prevent or lessen them, by enlarging, and where the level will admit it, deepening and widening the outlet, that the water may at all times have a more free and easy discharge. In some cases, the lake has been surrounded by an embankment, extending not only along its sides, but along those of the streams that flow from it, and that by which it is discharged, as far as the level requires; nay, it must sometimes be carried to the higher ground on both sides, to prevent the flood from having any access to the flat land liable to be overflowed. This however, is a very operose and expensive undertaking, and can only be effected, where a drain from the embanked ground, will fall into a river below the lake; otherwise the ground that has been embanked, would be filled with water.

3. *Protection against Rivers.*—There are two modes by which this can be effected: 1. Deepening the channel; and, 2. Raising embankments to protect the flat ground in their neighbourhood.

1. Where the course of a river is in a straight line, or nearly so, it hardly ever makes any encroachment on its banks, unless perhaps in very large rivers, when they rise above their usual level, either by an increase in their own waters, or their flow being in some degree interrupted by the tides. Hence, whenever a river is narrow in its channel, and winds considerably, any mischief which it commonly occasions, may be prevented, by deepening and straightening the course of the stream. In one instance, where this improvement has been effected, it has produced the following important advantages. The waters, which in their crooked course, were formerly almost stagnated, now run at the ordinary rate of the declivity given them. They never overflow their banks. Cattle can now pasture upon those grounds in which they would formerly have been swamped. The surface of the water being now, in general four, and sometimes six feet, below that of the adjacent fields, this cut serves as a general drain to the whole valley; so that three hundred acres of meadow, may be converted into arable land; sixty acres of moss, may be improved into meadow; and five hundred acres of arable land, are rendered of double their former value ([475]).

2. The protection of banks against a river, to prevent its overflowing and inundating large tracts of country, if judiciously executed, is the simplest and easiest of all sorts of embankments. Few rivers of common size rise more, even in the greatest floods, than five or six feet above their customary level, unless they meet with some considerable interruption or confinement in their course, which probably can, with little difficulty, be removed. In some cases, this may even preclude the necessity of embanking; but where that is necessary, the embankments on both sides, ought to be placed at a sufficient distance from each other, so as to contain with ease between them, the largest contents of the river, in the greatest floods. The distance and height necessary to be attended to, in forming the banks, may easily be ascertained, by measuring a section of the river, when at its highest, or when the flood-mark is visible.

When a sufficient distance is allowed between the embankments, their perpendicular height need not exceed four or six feet, but their slope should be considerable. If irremoveable obstacles are in the way, which cause the river to rise higher, the banks must be made, either more distant, or higher in proportion.

The materials for making these banks should be taken, as much as possible, from the sides of the river, which will have the double effect, of widening the river, and forming the embankment; and there should be a trench on the inside, (from which materials may also be taken), with some sluices, to discharge any water from the land side. It is proper to add, that sluices ought likewise to be made, for admitting the water from the river, the advantages of which, for fertilizing meadows, at certain seasons of the year, cannot be doubted ([476]).

When the facility, and the trifling expense at which this improvement can be effected, are considered, it is matter of surprise, that extensive tracts of the richest meadows, should be allowed to remain in a state liable to be overflowed by every flood. When these floods take place during the winter, or early in spring, the water deposits a fertilizing slime, which promotes vegetation, and is friendly to the growth of the best kinds of natural grasses. But the floods often come, when they are least of all desired, when the grass is far advanced, when the hay into which it is converted, is ready to be carried to the stack ([477]), or when the crops of grain are ready to be harvested. A crop may thus be destroyed, the value of which would have erected an embankment, that, with moderate repairs, might have preserved it in perpetuity ([478]).

One great cause that prevents the improvement of such meadows, is, that, in England, many of them, after the hay has been cut, are in a state of commonage, the remains of feudal barbarity. In such cases, the most spirited and well-informed cultivator, is checked in his exertions to ameliorate that property in which others are thus interested, if they will not contribute to the expense. *A general law* for promoting the improvement of meadows thus circumstanced, would be of essential benefit to extensive and valuable tracts, and add considerably to the produce and opulence of the country.

In Scotland, the strict fetters of entailed estates, are a great obstruction to such improvements, which a general law, with proper regulations, might in a great measure obviate.

2. *Reclaiming Land from the Sea, or at the Entrance of large Rivers.*

The embanking of land that has been, perhaps for ages, overflowed by the sea, by large lakes, or rapid rivers, is one of the greatest and boldest enterprises attempted by man; and the success with which it is generally attended, is an ample proof, of what human industry is capable of effecting, when its powers are called into action, and when self-protection and interest are the objects in view. The works of this sort executed in Holland, would have been deemed incredible, had they not been accomplished in our own immediate neighbourhood; nor are there wanting examples of such embankments in our own country, which do credit to the skill and enterprising spirit of those by whom they were undertaken.

The first object to be considered, before attempting to reclaim land, which, at low water, is left uncovered by the sea, is whether or not the soil to be gained, is of a nature capable of cultivation, and fit for the other purposes of agriculture; for in many cases, what is exposed at low water, and might easily be embanked, is an accumulation, to a great depth, of barren sand or gravel, unfit for any useful purpose ([479]).

On many parts of the coast however, the sea, at low water, recedes so far, as to leave dry, large portions of surface, in the bays and creeks of the shore, where the soil is of a rich and fertile kind, being rather a deposition of fine earth, washed down from the land above, than of barren gravel or pebbles thrown up by the sea. Land of that description will, in general, amply repay the expense of the embankment; the amount of which must depend upon the depth of the water, the force of the tide, and the prevalence of winds in that quarter.

At the entrance of large rivers, whose estuaries are wide, and in which the tide ebbs and flows, immense tracts are frequently left bare at low water, where much fertile land may be acquired. Embankments, in such cases, have strong claims to the consideration of those active and public-spirited individuals, whose estates are contiguous, and by whom the work may be executed at their joint expense.

The plans for carrying on such undertakings, do not belong to this work ([480]). But from the preceding observations, it is sufficiently obvious, that embanking is one method of improving, or acquiring land, well entitled to general attention, and in many cases, to public encouragement.

Concluding Observations to Chapter III.

Whoever has fully considered the various particulars above detailed, must be astonished at the perfection, to which these branches of the art of agriculture have been already brought, in our time, and in this country. These were greatly promoted, by the establishment of a Public Institution, whose object was, not only to collect and diffuse useful information, but to excite a general spirit for its advancement. From the processes above described, it is evident, that there is hardly any soil, however barren, which may not be rendered in some degree productive; and whose fertility, under judicious management, may not even be periodically increased. With such means at our command, with such a foundation of national prosperity, as an improved system of agriculture furnishes, there can be no doubt, that the subjects of this realm, if wisely governed, may enjoy all the necessaries, most of the comforts, and many of the innocent luxuries of life.

CHAP. IV.

OF THE VARIOUS MODES OF OCCUPYING LAND.

Introduction.

THE principal articles of food, and the chief materials of human industry, are obtained from the soil. In order to procure them, it is necessary for man to exert both his physical powers, and his intellectual faculties. By means of these exertions, he is enabled to raise a greater produce from the soil, than is requisite for the sustenance and accommodation of those who are employed in its cultivation. Unless a surplus produce both of food, and of the materials of industry be raised, society would remain stationary, and every species of improvement, in the condition of man, would cease. It is therefore a most important subject of inquiry, "How the greatest surplus produce may be procured, by a "judicious management of the surface of the earth?" There are four modes by which this can be effected :—

1. Cultivating land for arable crops.
2. Appropriating it to herbage.
3. Employing it as a garden or orchard; and,
4. Dedicating it to woods and plantations *. Each of these modes shall be briefly considered.

PART I.

ON THE CULTIVATION OF ARABLE LAND.

IN treating of this subject, the particulars to be discussed are, 1. Those operations in husbandry which take place, from the ploughing and ridging of the land, until its produce is ready for delivery.

2. The rotation of crops best adapted for different soils and situations, more especially those, which furnish the greatest quantity of produce, without exhausting the soil. And,

3. The extent to which spade-husbandry is advisable, in the culture of arable land.

* Gardening, and the management of orchards, woods, and plantations, are essential branches *of agriculture*, taken in its *more extensive sense;* and cannot, therefore, with any degree of propriety be omitted, in *a general treatise on the subject*, though many practical farmers are not aware of their importance and connexion with their pursuits.

1. *On the Operations of Husbandry in the Production of Crops, and in preparing the Produce for Market.*

Previous to the commencement of arable operations, it is necessary, 1. That the soil be cleared of any substance which might either obstruct its cultivation, or become detrimental to the crop;—2. That it be of a texture or degree of openness favourable to the growth of plants;—and, 3. That it possess fertility sufficient for the production of those articles proposed to be raised on it. These particulars being arranged, the subsequent operations may be classed under the following general heads:

1. Ploughing.
2. Ridging.
3. Scarifying.
4. Harrowing.
5. Rolling.
6. Choice of seed.
7. Change of seed.
8. Quantity of seed.
9. Preparing the seed.
10. Season for growing.
11. Sowing broad-cast.
12. Drilling.
13. Dibbling.
14. Transplanting.
15. Hoeing.
16. Treading.
17. Culture, while growing.
18. Reaping.
19. Harvesting.
20. Thrashing.
21. Dressing, or winnowing.
22. Improving the quality of grain.
23. Preservation till sold.
24. Straw.
25. Stubbles, and
26. Gleaning.

Some observations, 1. On the accidents to which grain is liable; and, 2. On the chief diseases of wheat, are offered in separate papers in the Addenda.

Sect. I.—*Of Ploughing.*

The various benefits arising from good tillage cannot be too much inculcated. By tillage, both the composition and the consistence of the soil are improved, and adapted to the nature of the different species of cultivated plants. By its assistance, the manure and the seed are most advantageously deposited. It is calculated to give considerable relief from surface-water, and undue moisture, by enabling the cultivator to increase the depth, and to adjust the surface of the soil ([1]). It can be employed to assist in destroying almost all the varieties of weeds which lurk in the soil, either as roots or as seeds, bringing the former to the surface, and inducing the latter to vegetate. By the same means, various tribes of insects, and their larvæ, (more especially if the ploughing is given before frost), are got rid of. And by exposing the soil to the influence of the atmosphere, the decomposition of dead substances, and, at the same time, the growth of living plants, are promoted. As all these important advantages are to be obtained by the operations of tillage, it is not to be wondered at, that skilful and experienced husbandmen have, in all ages and countries, entertained the highest ideas of its utility ([2]).

Indeed, where tillage is imperfect, there can be no good husbandry. In one extensively cultivated district, it is stated as more than probable, that a third part of the crops collectively, on some of the best fields, is every year lost, *through the want of sufficient tillage:* nay that perhaps, from one-fourth to one-sixth part of the produce, *of the arable lands of the kingdom, is in general lost,* from the same cause ([3]). This is a subject therefore, that cannot be too minutely investigated. It is well known, that the horses of a good ploughman, suffer less from the work, than those entrusted to an awkward and unskilful hand; and that a material difference will be found, in the crop of those ridges, tilled by a bad ploughman, when compared to any part of the field, where the operation has been judiciously performed.

It will be necessary here to consider, first, the best mode of ploughing; and then, other particulars connected with that operation.

1. *Mode of Ploughing.*

The simplest, the most economical, and the most effective mode of ploughing, *for general purposes,* is, by a swing-plough, with a pair of horses, and without a driver. In the sandy soils of Norfolk, a wheel-plough will run over more expeditiously, with a broad and thin furrow-slice, a greater extent of ground; but in loamy and clayey soils, wheels must always be an incumbrance, and occasion additional labour to the horses.

In working with the two-horse swing plough, the off-side horse walks in the furrow already made, the near-side horse on the untilled land, the ploughman in the new furrow. His skill is proved, when there is no *baulking,* or portion of the land left untilled, and when the furrow-slice is completely turned over ([4]). If the bottom of the furrows remain with pieces of land uncut, they preserve the thistles from destruction, and prevent the descent of moisture from above, to the open furrows left for carrying it off. Hence the land necessarily becomes soaked with water.

2. *Form of the Furrow-Slice.*

There is great difficulty, in considering the operation of ploughing, to determine the width and the depth of the furrow-slice, as they must vary, according to the object which the farmer has in view, the nature of the preceding and succeeding crop, and other circumstances. The following table will give some idea, of what is considered to be a proper size, in different circumstances, though it must be regulated, in almost every case, according to the nature of the soil that is to be worked:—

Table of Ploughing.

Nature of the Ploughing.	*Width.* Inches.	*Depth.* Inches.
First fallow furrow, ...	10	6-8-10-12
Second furrow ditto, ...	9	6-7
Third furrow, ...	8	5½
Fourth furrow, ...	7	5
Seed furrow, ...	7	4
Oat crop from turnips, ...	9	4-5
Oat crop from clover ley, ...	9	5-6-7
Beans, when on one furrow, ...	9	6-7-8-9
Beans, if with a second furrow, ...	9	5
Barley, first furrow, ...	9	6-7
Barley, second furrow, ...	8	5
Barley, last furrow, or after turnips,	8	4
Potatoes, first furrow, ...	9	4-6
Potatoes, second furrow, ...	8	5

The following general rules regarding the depth of ploughing, are recommended to the reader's attention, as the result of much careful inquiry respecting this interesting subject.

3. *Maxims respecting the proper Depth of Ploughing.*

1. The depth to which land should be ploughed, must in some measure be regulated by the deepness of the soil. On thin soils, more especially on a rocky substratum, the ploughing must necessarily be shallow; but when the soil, whether light or strong, will admit of it, the furrow ought to be made, as deep as a pair of horses can accomplish ; and it is occasionally advantageous, to plough it even with four horses, particularly at the commencement of every fresh ro-

tation. 2. Deep ploughing is highly advantageous upon every soil, excepting those where the substratum is of an ochery sand [5]. In fact, shallow soils, with such a substratum, are scarcely worthy of being cultivated, unless in situations, where much alluvial compost, or short town manure, can be procured. 3. It is a general rule, never to plough so deep, as to penetrate below the soil that was formerly manured and cultivated, excepting upon fallow, and then only, when there is plenty of lime or dung to be added to the new soil for improving it [6]. 4. When fallowing land, it is advisable, to go as deep as possible with the first furrow, by which the subsequent furrows will be more easily executed, thus exposing the soil to the winter's frost, and to the summer's heat: but should *a strong soil* be ploughed in spring, for a crop of oats, the furrow ought not to be deeper than five or six inches. 5. Deep ploughing is advisable on moorish cold soils, when they are first brought into cultivation, as it affords a greater scope for the roots of plants to procure nourishment, allows the superabundant moisture to subside from them, and prevents the summer drought from making an injurious impression on the growing crops: but where such poor soils are retained in cultivation, the depth of ploughing ought in some degree to be in proportion to the quantity of manure that can be applied [7]. 6. Immediately before the seed is sown, it is unnecessary to plough to a greater depth, than that to which the roots of the plants usually extend; and as beans, clover, and turnips, (the tap-rooted kinds commonly cultivated in this country), seldom send their shoots above seven or eight inches down into the soil, and the culmiferous species in general, not so far, it is probable, from these circumstances, that from seven to eight inches may be deep enough for all the purposes of ordinary culture.

Deep ploughing is not to be recommended; 1. When lime or marl has been recently applied, such articles having a tendency to sink from their weight, and the moisture which they imbibe. 2. Where turnips have been eaten off by sheep, on the land where they were grown. 3. When grass, only two or three years old, more especially where it has been pastured with sheep, is broken up; because, owing to the extreme condensation of the soil, by the trampling of the sheep, a furrow, even of a moderate depth, *to appearance*, will make the plough penetrate, below the staple that had been cleared, by the culture given during the previous fallow. By this means, myriads of the seeds of annual weeds are raised to the surface, where they vegetate, and materially injure the crop cultivated, besides replenishing the soil with a fresh supply of their own seeds. In all these cases, a depth of from four to five inches will be found sufficient. And, 4. If land is infested with natural grasses, which generally run much on the surface, the first ploughing should not be deeper than is necessary for turning up the roots of the grasses, that they may be destroyed. It is also necessary to observe, that where the substratum is of an unfertile quality, ploughing deep cannot be safely adopted, unless the land is under the fallow process, so that the new soil may be exposed to atmospheric influence, and improved by calcareous and putrescent manures, which may then be applied with peculiar advantage.

It is now proper to give a general view of the advantages of deep ploughing, a practice which slovenly farmers, and even those who in other respects merit a different character, too often neglect; whereas those who have acquired superior skill in their profession, in order that they may be enabled to give a thorough deep ploughing, at the commencement of every rotation, keep such a number of strong ploughs, calculated even for four horses, as may be adequate to the size of their farms, by means of which, the stiffest soil may be cultivated, to the proper depth, whenever it is desirable.

4. *Advantages of deep Ploughing* ([8]).

1. Bringing up new mould, is peculiarly favourable to clover, turnips, beans, and potatoes; and, indeed, without that advantage, these crops usually diminish in quantity, quality, and value. 2. Deep ploughing is likewise of great consequence to every species of plant, because it furnishes more means of nourishment to their roots, and, above all, as it counteracts the injurious consequences of either too wet or too dry a season. This is a most important consideration; for, if the season be wet, there is a greater depth of soil to absorb the moisture, so that the plants are not likely to have their roots immersed in water; and in a dry season, it is still more useful, for in the lower part of the cultivated soil, *there is thus a reservoir of moisture*, which is brought up to the roots of the plants, by the evaporation which the heat of the sun occasions ([9]). 3. By deep ploughing, also, the ground may be more effectually cleared of root-weeds of every description; in particular, it is the best mode of eradicating thistles. 4. By deep ploughing, animal and vegetable ma-

nures, which have a tendency to rise to the surface, are properly covered. This cannot be done by shallow ploughing, in consequence of which, much of the value of these manures is lost. And, 5. By deep ploughing, a more abundant crop is raised, than can be got from a shallow furrow, and the crop is more equal over the whole field ([10]). An intelligent farmer indeed, after explaining, That deep ploughing increases the staple of the soil, keeps the roots of the corn from being injured by wetness, and also enables the crop longer to resist drought, adds, "*I have ever found that practice attend-*" *ed with good crops, when ridges, shallow ploughed, in the same* "*field, were but indifferent* ([11]):" a remark which furnishes a decisive proof in favour of deep ploughing. When strong lands also, are only thinly ploughed, the finer pulverized parts, are apt to be washed into the furrows and lost.

5. *Preparation for deep Ploughing.*

In Kent, the farmers have a practice which merits the attention of their brethern in other districts, that of *broad-sharing* their wheat and other stubbles, as a preparation for pease and beans, and to enable them to plough deeper with more advantage. It is done by means of a *broad-share*, or strong plate or hoe, with the ends a little thrown back, from 18 to 26 inches wide, having a staple in the upper surface, by which it is fixed to the plough. With this implement, the ground is cut to the depth of three or four inches, and the soil thrown into slight baulks, which is done at the rate of three acres per day, by three or four horses. These baulks are harrowed down, and all weeds and rubbish carefully carried off. After this operation, which is favourable to the destruction of weeds, and collects a great quantity of materials for the dunghill, it is not difficult to plough the land to any proper depth, and the raw bottom is turned up, and meliorated by the winter's frost, and the succeeding summer's sun, where fallowing is practised ([12]).

6. *Manner of laying the Furrow-Slice.*

In several districts in England, as in Norfolk, where the land is dry, and consequently does not require ridges, or where the seed is deposited by the drill or dibble, it is usual, to lay the furrow-slice quite flat, but in Northumberland, and in Scotland, a contrary system is adopted. It is founded on this idea, that as two of the principal objects in ploughing are, to expose as much surface as possible to the influence of the atmosphere ([13]), and to lay the land, so that the harrows may, in the most efficient manner, raise mould to cover the seed, these objects are most effectually accomplished, when the furrow-slice is raised with a proper shoulder, forming an angle of 45°. The depth of the furrow for that purpose, ought in general to bear a due proportion to its breadth, that is, about two-thirds, or as six inches deep are to nine broad ([14]).

7. *Seasons for executing the Work.*

These must greatly depend upon the soil, the state of the weather, and the climate. In very dry light lands, it is advisable, that ploughing should be carried on in damp weather, particularly the last ploughing, and the sowing of the seed ([15]). On the other hand, soils, of so retentive a nature, as to hold water much more in quantity than is useful to vegetation, ought to be ploughed in a medium state, neither wet nor dry. When perfectly dry, they will not plough at all, being so hard and tenacious; and if ploughed when wet, the land is ruined by poaching, and plastering; hard clods are formed, which it is very difficult afterwards to reduce; and a whole crop may consequently be lost. This circumstance, renders the cultivation of clayey soils extremely difficult.

In Great Britain, where the winter is long, and the spring shorter than in many other countries, the operations of agriculture must be expeditiously conducted; hence it is a good rule, to divide the labour of ploughing, as much as possible, between harvest, winter and spring. All corn stubbles therefore, (which are without clover or other seeds), should be ploughed as soon after harvest as the other work of the farm can permit, and thus put into a state for receiving benefit from the winter frosts, and to be ready for spring culture, on the system of scarifying, to be afterwards described (Sect. 3.) ([16]).

8. *The Hours of Working.*

Where the arrangement of farm labour is properly regulated, plough-horses should always work two journeys or yokings in the day, except in the shortest days, when they are not unyoked, but have a feed in the field at noon, by which any loss of time, in travelling to and from the stable, is prevented. The plan of two yokings a-day is highly advantageous, though it does not seem to be understood in those parts of the united kingdom, where it is the practice to go but one yoking a-day, even in the longest days of summer ([17]). That practice probably originated in the common-field system, and still continues, though the land to be ploughed, is very remote from the farm-offices. This is an additional proof, of the importance of having these offices in a central situation. In some districts, the farmers allow four horses for each plough, two for a journey of five hours in the forenoon, and the two others for five hours in the afternoon. This practice, which must greatly increase the expense of cultivation, cannot be too strongly reprobated.

9. *Extent done in a Day.*

This must vary according to the quality of the soil;—the width of the furrow-slice;—the depth of ploughing;—the length of the field or ridge;—and the season of the year when the work is performed. Some general idea, however, of the extent done, and of the time required to do it, may be given.

A pair of horses can plough, of a medium soil, a statute acre per day, in two journeys of nine hours in all, provided the soil is not obstinate and tenacious. That extent is ten chains long, and one chain, or 66 feet broad. There are 88 furrow-slices, nine inches wide each, in 66 feet, so that the horses ploughing a furrow-slice of that width, travel 11 miles in ploughing an acre, exclusive of turnings. If the turnings are equal to one-tenth, the horses actually travel 12 miles and 176 yards, in ploughing a statute acre ([18]). In one day, that is very good work for two horses; yet it is a very slow pace, when divided into nine hours' work. In a dry fine soil, and on level ground, a pair of good horses, will plough twelve chains; on wet heavy land, nine; but sometimes not more than eight chains. In crossing or stirring turnip land, in summer or spring, they will do sixteen chains, and in some very fine land two acres. The common day's work in Norfolk, is from an acre, to an acre and an half ([19]). In that district, the horses generally travel at the rate of three miles an hour ([20]); and the draught is so light, as to be but little felt by the animals.

A zealous agriculturist, (the late Earl of Mar), who paid much successful attention to several branches of husbandry, calculates, that the number of yards travelled in

ploughing an acre and a half, with a furrow-slice of nine inches, is - - - - - 29,040 yards.
With a furrow-slice of eight inches, - 32,640 ditto.

The following tables are given from the same authority, founded on the above principle of calculation.

TABLE, shewing the Quantity of Ground ploughed, according to the different Breadths of the Furrow-Slices, and the Rates of the Horses walking.

Breadth of the Furrow-slice.	Rate per Hour.		Length of Way travelled in ploughing.	Quantity of Ground ploughed.		Breadth of the Furrow-slice.	Rate per Hour.		Length of Way travelled in ploughing.	Quantity of Ground ploughed.	
Inches.	Miles.	Furlongs.	Yards.	Roods.	Poles.	Inches.	Miles.	Furlongs.	Yards.	Roods.	Poles.
8	1	—	14,144	2	24	8	2	—	28,168	5	7
9	—	—	14,157	2	37	9	—	—	28,193	5	33
10	—	—	14,148	3	11	10	—	—	28,188	6	21
11	—	—	14,157	3	22	11	—	—	28,215	7	5
The rate of walking being one Mile and half a Furlong.						The rate of walking being three Miles.					
8	1	½	14,960	2	30	8	3	—	42,296	7	31
9	—	—	15,004	3	4	9	—	—	42,350	1	30
10	—	—	15,012	3	19	10	—	—	42,336	9	32
11	—	—	15,048	3	32	11	—	—	42,273	10	27
The rate of walking being one Mile four Furlongs.						The rate of walking being four Miles.					
8	1	4	21,216	3	36	8	4	—	56,336	10	14
9	—	—	21,120	4	14	9	—	—	56,386	11	26
10	—	—	21,168	4	35	10	—	—	56,376	13	2
11	—	—	21,186	5	14	11	—	—	56,430	14	10

It is supposed, that in England in general, the common breadth of the furrow-slice is about nine inches; but the generality of the farmers in Norfolk, for various reasons, prefer having their furrow-slices fully eleven inches broad (21); so that the same quantity of ground, ploughed by them in a given number of hours, must be considerably greater, than that worked in other districts, where the nature of the soil, requires to have the furrow-slice of a narrower breadth.

The effect of short ridges, and consequently of frequent turnings, is most strikingly exemplified, in the following table, drawn up by the nobleman formerly alluded to, from actual experiment.

Names of Fields.	Length of Ridges.	Breadth to give an Acre.	Breadth of the Furrow-slice.	Numbers of Furrows in the Acre.	Time taken up in turning.	Time taken up in stirring the soil.	Number of Hours in the Day's Work.
	Yards.	Feet.	Inches.		H. M.	H. M.	H. M.
7. South Gubber, ...	78	186	8	279	4 39	3 21	8 0
3. East Loch, ...	149	98	—	147	2 27	5 33	8 0
11. Harperhill, ...	200	73	—	109	1 49	6 11	8 0
2. South Muir, ...	212	69	—	103	1 43	6 17	8 0
17. Long Bog Croft, ...	274	53	—	79	1 19	6 41	8 0

Thus it appears, that when ridges are 78 yards in length, no less a space of time than four hours and thirty-nine minutes is spent in turnings, in a journey of eight hours; whereas, when ridges are 274 yards long, one hour nineteen minutes is sufficient, in the same length of time. What then must the waste of time be, in small paddocks, and when four, or perhaps five horses are yoked, one after the other.

10. *The Expense.*

The cheapest ploughing, in any part of the United Kingdom, is upon the light lands of Norfolk. It was formerly as low as from 3s. to 4s. per acre; but now, two horses and one man, cost the farmers at the rate of 9s. per day; hence, as they generally plough an acre and a half a-day, the expense is about 6s. per acre. But when ploughing is done by hire, the contractor finds every thing, and charges on an average 8s. per acre [22].

The expense of ploughing in Scotland, from the difference of soil, and the greater depth to which the operation is carried on, is higher than in Norfolk. A ploughman, with a good pair of horses, properly fed, including the expense of the plough, the harness, &c. must, on an average, cost the farmer about L.115 per annum; and deducting from the year 52 Sundays, and allowing other 13 days to be lost on different accounts, and supposing the team to be constantly employed, the expense of ploughing one acre, averaging the different states of the soil when ploughed, and the different objects in view, cannot be estimated at less than 8s. 6d. and in many cases it exceeds that sum.

By an experiment made in Oxfordshire, it appeared, that with four horses, an acre could not be done under 14s. [23].

In Derbyshire and Kent, the cost is from 12s. to 15s. per acre [24], and in many cases, 17s. In the latter county, from four to six horses are employed, to plough even a loamy soil.

But it is in Middlesex, where the most expensive system of aration is carried on. There, four horses at length, at 14s. per day, a man at 2s. 6d., and a driver at 1s., total 17s. 6d., plough so little, that the expense is estimated at more than at 21s. per acre [25].

Wherever only two horses have been employed to work in a plough, the circumstances of the farmers have greatly improved, owing to the expense of cultivation being so materially diminished. This ought to be a strong inducement, with gentlemen of landed property, to introduce upon their estates, the practice of ploughing with only two horses, and of going two journeys a-day [26]. The prohibition of long teams, unless in particular cases, would not only be a real improvement, but would ultimately produce, an increase in the rent-rolls of those proprietors, who should establish so useful a system [27].

11. *Cross-Ploughing.*

Though ploughing must in general be lengthwise, yet crossing the ridge is occasionally advantageous; sometimes to secure the complete stirring of the soil;—sometimes to promote the intimate intermixture of the manure, after a crop of drilled turnips;—and always, when the ground is summer fallowed. The celebrated Tull recommended, not to plough across the land, till the third furrow was given [28], and this recommendation is generally followed by farmers in England on clay soils [29]; but in Scotland the cross-ploughing is always given with the second furrow. The head-ridge cannot well be cross-ploughed, but it should be done first, whenever there is more than one ploughing. If then neglected, it gets only one stirring afterwards, and the produce is inferior to what it would otherwise have been, the land not being so well pulverized.

12. *Trench Ploughing.*

The plan of ploughing double furrows, either by a plough with a skim coulter, or by means of one plough following another, though not often practised, has been recommended, as an advantageous mode of breaking up grass land. The first plough pares off the surface from one to two inches thick, and turns it into the bottom of the last made furrow; while the second plough, going three or four inches deeper, turns upon it a sod of friable earth, which, being destitute of fibrous roots, harrows to a fine mould with little difficulty. The additional expense, on common occasions, is only 6s. per acre, which, in breaking up old swards, on clayey soils, is almost saved in the expense of harrowing; but where two additional horses and a driver are necessary, the extra cost will be from 7s. to 10s. per acre.

In trench ploughing, it is in general necessary, not to go beyond the usual depth, but merely to separate the vegetable mould, or cultivated soil, from the lower stratum [30]. But in the sandy districts of Wiltshire, it is not uncommon, when a second plough follows in the furrow of the first, to go so deep as to throw up new soil, and to bury that which is supposed to be exhausted. This is done likewise in many parts of Devonshire, and is the same system, which, in Flanders, is executed in sandy soils, by manual labour. This plan however, can only with propriety be adopted, where there is in reserve, an extra depth of good soil, which may be turned up, when the surface indicates exhaustion. Where the subsoil is of a bad quality, it is not advisable to go so deep [31], and the soil that has been long in cultivation, is kept uppermost.

13. *Ploughing-Matches.*

From the great importance of good ploughing, every means should be adopted, to extend a practical knowledge of the art, in its greatest state of improvement; and no plan has been found more effectual for that purpose, than the establishment of ploughing-matches, by which a spirit of competition among ploughmen is excited, by rewarding those who excel (32). At such meetings, farmers have been instructed, when they only came to be amused; their prejudices have worn away; and they have been induced to try new instruments of husbandry, and new modes of culture. Were it possible to impress upon the minds of farmers in general, the great importance of good ploughing, more especially the advantages of using ploughs with two horses, and without a driver, the expenses of cultivation would be greatly diminished, and several millions in value, would be added, to the produce of the United Kingdom (33).

Sect. II.—*Of Ridging.*

The next point to be considered is, the utility of having the land divided into ridges, and where that is judged expedient, the form in which they ought to be made.

Dry soils being deficient in moisture, ought to be tilled flat, as any sort of draining, which the furrows might afford, would be prejudicial rather than advantageous. In Kent, dry land, cultivated by the common turn-wrest plough, is left as level as if it were dug with a spade. The moisture is thus equally diffused, and retained under the surface of the earth. This practice is likewise thought to be convenient to the operations of the mower, (much of the crop being there cut down by the scythe): it is also favourable for the conversion of arable land into grass; and it effects a considerable saving of labour (34). The plan of cultivation without ridges, is sometimes done, by going round and round a hill, from the circumference to the centre, or from the centre to the circumference. This mode requires little more force than common ploughing: it is likewise an expeditious mode, as there is no occasion for turning, and is economical, as by it, every inch of the soil is moved (35). But ridges are essential in wet soils and climates (36), operating as open drains, without the assistance of which, the crops would be rarely productive in rainy seasons. It is therefore, of much importance to the farmer, to be fully master of the rules, by which ridges can be formed to the best advantage. These may be considered under the following heads: 1. The proper length of ridges; 2. Their breadth; 3. Their straightness; 4. Their height; and, 5. The proper line of direction, when the ground is steep.

1. *The proper length of Ridges.*

The length of a ridge must vary according to the size of the field, the acclivity of the ground, and the nature of the soil, whether wet or dry.

In fields with much acclivity, ridges of about 150 yards, (7 chains), are found to be of a convenient length. A longer ridge, in such situations, tends to fatigue the horses; and if much rain or snow should happen to fall on sloping land, recently ploughed, the finest particles of the soil, and the most valuable parts of the manure, will be washed out of the ground, and conveyed, along the furrows, with too much facility, by a long run, to the headland, or to the nearest brook or river.

In wet soils, where the ground is flat, a ridge from 240 to 300 yards, (from 11 to 14 chains), may be considered as the proper length. If it exceed 300 yards, the water may not easily get away, or it may be necessary to make a head-ridge across the field, so as to form a level for carrying off the extra moisture;—or, at any rate, to make *grips*, or small open cuts, in the lowest parts of the field, to collect and convey the water to the ditch.

In soils of rather a dry nature, and where the land is level, the ridge may be still longer; though on the whole, a ridge from 350 to 400 yards, (from 16 to 18 chains), seems to be the preferable length, when circumstances are suitable. If it exceeds the latter size, horses are apt to be fatigued from going so long on a stretch; and the loss by turning, when the ridge extends to 350 yards, is not considerable. Besides, when the ridge is very long, it is not only sown with more difficulty, but it has a tendency to discourage the reapers, when employed in cutting it.

2. *The Breadth of Ridges.*

Few subjects in husbandry, have occasioned a greater diversity of opinion, than the breadth of ridges. The reasons urged in favour of the different sizes, shall therefore be assigned, and the reader left to judge, from the statements laid before him, which is most suitable to the soil he cultivates.

In poor, clayey, wet soils, it is maintained by many intelligent farmers in England, that the ridges should be made only from three to six, or, at the most, seven feet broad; that on wet soils, small ridges keep the soil moderately dry; and that on thin soils, the staple is increased, by putting the earth of five feet upon four, while the produce is as great, as if the whole land had been under crop. Plants, they contend, are more uniformly healthy, from the freer admission of air, and ripen more equally on narrow, than on broad ridges. There is also an advantage in cutting down the crop, as each reaper may have a separate ridge ([37]).

A variety of ingenious arguments have been urged, in favour of ridges, varying in breadth from twelve to fifteen feet. It is said, that they are easily kept dry;—that the furrows are not apt to be rendered bare;—that the seed can be sown at all times, even with an adverse wind, at a single going;—that two harrows, going once about, completely cover the ridge; and that this is a proper proportion or breadth for three reapers.

On the other hand, the farmers of East Lothian, where this subject has been particularly studied, prefer ridges of eighteen feet, which they consider to be, not only better calculated for preserving the land from receiving injury by wetness, but also as tending to facilitate, the several processes of dunging, sowing, harrowing and reaping. Indeed, where the soil is deep enough to admit of three gatherings from the flat, without sustaining injury, they are of opinion, that a breadth of twenty-four feet will be found useful in wet soils.

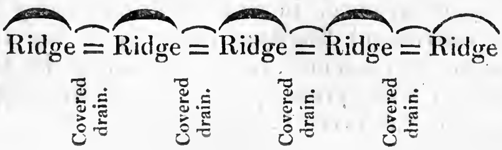
The practice, in various parts of England and Scotland, respecting the breadth of ridges, on wet soils, is so totally at variance, that it is supposed to be partly attributable to difference of climate. In Scotland, it is thought, that narrow ridges, unless there is an acclivity, soon become wet and poached, and are long in getting dry; the rain that falls, remaining in the interfurrows, and soaking into the ground; —that the crowns cannot be raised sufficiently high, to be of much use in draining;—that turning the horses *short*, at the end of narrow ridges, is attended with difficulty;—that the loss of ground, by such a number of furrows, where no plant can properly vegetate, is enormous;—and that it is proved by experience, in climates more rainy than the southern districts of England, (namely, in the Lothians), that the strongest and most retentive soils, are kept perfectly dry in ridges, when properly rounded, of from eighteen to twenty-four feet in breadth.

In opposition to these doctrines, it is contended, that broad and high ridges are not favourable to the useful operation of cross-ploughing;—that they cannot well be harrowed by horses walking in the furrows, which is an advantageous practice;—that they are not well calculated for the drill husbandry;—that when ridges are narrow, the crowns may be so well raised, that no rain can lodge upon them; and that every possible objection to narrow ridges, on the score of wetness, is obviated, where *hollow-draining*, as practised in Essex (39), is adopted;—that the furrows are not lost, as they act not only as drains, but admit much air; —that no inconvenience can arise from any length of furrows, to a field ploughed in very narrow ridges, if proper use be made of grips;—that where the ridges and furrows are sufficiently narrow and numerous, the soil cannot be washed away;—and as a general maxim, it may be laid down, "*that as in dry porous soils, the ridges cannot be too broad, so in wet clays, they cannot be ploughed too narrow.*"

From these adverse statements, the reader will be able to judge, what size of ridge will best suit his soil and climate.

In regard to dry, porous, turnip soils, it is of little importance, whether ridges are formed at all, unless to regulate the sowing and cutting down of the crop. A thirty feet ridge is, in such cases, considered to be a proper width, as it saves time in ploughing, there being fewer furrows to clear out in finishing the field: it also saves time in forming the ridges, when the land has been cross-ploughed; and it keeps more moisture in the soil, than a ridge of less width.

The peculiar mode which has been put in practice, by an intelligent farmer in Scotland, (of having covered drains in the furrows of broad ridges), would probably be of use, in several districts of England, particularly in the Vale of Gloucester, as in wet seasons, and more especially in winter, each furrow, where these broad ridges are used, becomes a canal of stagnant water (40). The farmers in that Vale, have so far adopted the plan above recommended, as to plough a small ridge between the high ones; and they have nothing to do, but to put a hollow drain under these small ridges, in order to effect a most important improvement. The following sketch will give some idea of the nature of the operation:



The drains are generally about two feet and a half deep, and as narrow at the bottom, as an ordinary spade can conveniently work them. They may be filled with bricks, or small stones, to the depth of rather more than a foot, and covered in the usual manner with straw and earth.

It is evident, that in addition to every other consideration, the breadth of ridges must also depend upon the mode of culture. Where the broad-cast system is followed, the size must be calculated, for enabling the sower to scatter the seed equally over the land (40). Whereas, when the drill system is adopted, the breadth must be adjusted to the size of the machine. In wet or tenacious soils, it is an excellent plan, to make the horses walk in the furrows, and to drill a whole ridge at once.

3. *Straightness of Ridge.*

It is of the greatest advantage, to have the ridge of an equal breadth, and as straight as possible. It is the very essence of good ploughing, to hold the plough even, which it never can be, if it has to work in a curve. Besides, ridges, when very crooked, measure more in the serpentine direction, than when taken in a straight line, and consequently they must require more labour in ploughing, harrowing, &c. than if they had been perfectly straight. That does not imply, that there is more land in the field; but an improper form, by impeding operations of the plough, materially tends to augment the labour. Every farmer knows by experience, how awkwardly the plough moves in such ridges, and that in finishing them, there must be much more turning. Where the ridges, also, are irregular, or broader at the one end than the other, a considerable waste of seed is likely to be the consequence; for the seed cannot possibly be scattered with the same regularity, as if the ridge were altogether of the same breadth (41).

In regard to crooked ridges, straightening and levelling them, in very stiff wet clays, are very difficult operations, and unless executed with considerable judgment and skill, will be productive of some temporary loss. They should never be attempted but in a year of fallow, and the straightened land, should be supplied, with considerable quantities of calcareous and enriching manures, and subjected to much cross ploughing, to mix the old and new staple, and to rouse the fertility of the new soil.

4. *Height.*

It is necessary that ridges, on wet land, should be well rounded, so as to form the segment of a circle, without being carried to so ridiculous an extreme, as is the case in Gloucestershire, where two men, standing in the furrows, cannot see each other's heads ([42]). For the purpose of elevation, the soil is gathered, in the course of ploughing the ridge, once or twice, according to its dryness or wetness. Indeed, in very wet lands, the soil has often been gathered thrice, with much success, especially for a spring crop; for this mode, not only lays the land dry through the winter, but enables the farmer to commence his operations sooner in the spring. The height, however, should not be too great; only sufficient to furnish a declivity, to let off the water; for when the crown is raised too high, one-half of the ridge is often covered from the sun, (a disadvantage which is far from being slight in a cold climate), and the crop, which is always best on the crown, is more easily shaken by the wind, than where the whole crop is of an equal height ([43]). Besides, with high ridges, there is a tendency to work the fertile soil to the centre, and to leave the rest of the land very bare, and consequently deficient in produce. There cannot be a worse error in tillage. But it may be remarked, that the height to which a ridge is raised by gathering, entirely depends upon the deepness of the furrow slices; for some farmers, by two gatherings, will raise the ridge as high, as others will do by three.

5. *Line of Direction.*

The last point regarding ridges, which it is necessary to consider, is the line of direction, more especially in steep grounds. There are four modes in which the ridges may be laid out on such declivities.

1. *When they are planned on the same Line or Level, thus:*

This is done, partly with the view of preventing the soil and manure from being washed down, and partly from the idea, that it is easier for the cattle to work it. But unless the subsoil is porous, it detains the water in the furrows. It is likewise an awkward mode of cultivation, if the common plough is used; and if a plough with a shifting mould-board, (usually called a *turn-wrest* plough), is employed, it always throws the furrow-slice down hill, and consequently brings lower and lower, the staple of the soil.

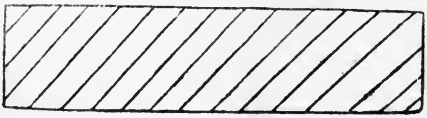
2. *When the Ridges are straight up and down.*

This is objected to on the ground that the soil and manure are both apt to be washed down, and when the plough is going up the declivity, the earth makes such a resistance, that the cattle have great difficulty in dragging the plough up the hill.

3. *From the top of the Bank sloping to the left.*

This mode also does not answer, for when the plough is going up, the ploughman has to force the earth against the hill, which makes but very imperfect work; and it does great injury to the cattle.

4. *From the top of the Bank sloping to the right.*



When the ridges are laid in this manner, the horses have a better footing, and the ground always falls from the plough, as it goes upwards, without any great exertions on the part of the ploughman or the cattle. By this plan, no part of the soil is forcibly turned against the acclivity; but it is so contrived, that, on returning down the hill, the furrows fall freely from the plough, and thus every inch of the soil is perfectly turned over. These diagonal ridges, are likewise extremely favourable to the cartage of both produce and manure. If there be soil enough, any ground, however steep, may be cultivated on this principle, *and by this mode, land may be ploughed, which would otherwise be impracticable* [44].

On this subject, it is farther to be observed, that the ridges should be directed north and south, if the ground will permit. By this means, the east and west sides of a ridge, have the influence of the sun equally divided between them; and the crops which they produce, will ripen at the same time [45].

Sect. III.—*Of Scarifying, and putting in Crops without Ploughing.*

It is remarked by an eminent author, that if one ploughing to the full depth be given, once in 12, 18, or 24 months, shallow tillage afterwards, by scaling, scarifying, scuffling, skimming, or broad-sharing, is, in many cases, preferable to frequent deep-working, more especially for wheat, which loves a firm bottom [46].

This doctrine, if not carried to an extreme, is, *in particular cases*, entitled to the attention of the practical farmer.

It appears, that the system of sowing upon the winter furrow, was adopted in Scotland many years ago, and was strongly enforced by Lord Kames, in his Gentleman Farmer, printed in 1776. He there proposed, that the surface should be pulverized by a strong harrow, the scarifier or grubber being then unknown in the Lothians [47].

The practice of sowing on the winter furrow, both oats and barley, has been followed with much advantage, in the counties of East Lothian, Kincardine, Dumfries, and Roxburgh, and the crops have always been more certain, and much more abundant, especially when a dry spring and summer took place. It thence evidently appears, that ploughing lands in spring, when sufficiently clean, and prepared before winter, is an unnecessary increase of labour for oats, and in many cases for barley [48]; that turning up a clay soil, at that season of the year, is a dangerous and precarious operation; and that all the advantages of a fine mellow surface, which cannot be regained after a spring ploughing, are lost. There is also the risk of rain during the operation, which, in many instances, puts the land so much out of good condition, as to render the chance of a crop very precarious.

The farmers in the Carse of Gowrie however, do not think the system applicable to their *strong soils*. They are of opinion, that it is impossible to keep the ground clean, and in such good order for a succession of crops, *without spring ploughing*. But the scarifying system goes upon the idea, that the ground upon which either barley or oats is proposed to be sown, has been previously cleared of weeds, either by a summer fallow, or by some cleansing crop, as beans; and does not depend upon any process to be administered, in the course of that very spring, on which the grain crop is to be sown.

The scarifier, with some improvements, being now established in the Lothians, under the name of "*grubber*," (49), there can be no doubt, that so beneficial a practice will spread, as much as the nature of the Scotch system of husbandry will admit of it, where oats generally succeed grass, which, in backward seasons, cannot be got ploughed sooner than February or March, in which case, the plan cannot be adopted. In regard to the ground that has carried turnips, and has been fed with sheep, it has been found, that scarifying is preferable to ploughing, for the succeeding crop.

With respect to England, it is maintained in several districts, that spring crops may be successfully sown without spring ploughing: that the land may be sufficiently stirred and pulverized by the scarifier or grubber (50); that it is of very great consequence, to expose a strong clay soil to the winter frosts, (which can only be done by ploughing in autumn, or the beginning of winter); the benefit of which practice would be lost, if that part of the soil, that had been meliorated by the frost and the atmosphere, were ploughed down. They consider it as absurd to bury the dry friable porous surface, which the frosts have left in so favourable a state, and upon which, if rain falls, no plastering ensues, as it dries speedily, and remains in a porous state; but which, if ploughed in spring, is often so impregnated with moisture, that if worked, it plasters, and the north-east winds harden it like stone. The plan, however, requires to be skilfully conducted to insure success. Mr Blaikie recommends, that the implements used should be worked lengthwise along the ridges, and immediately before the sowing.

Great attention should be paid to the state of the weather, and temper of the land, in working soils in that state. The whole process of stirring the ground, depositing the seed, harrowing, and water furrowing, should if possible be effected within the same day, and that may, in most cases, be readily accomplished, as no cross-ploughings, or cross-harrowings are required in the process. Clovers, and other grasses, succeed well, when sown with corn crops on strong land, cultivated in this manner.

These opinions are strongly sanctioned, in various instances, on a great scale, and by the practice of a number of farmers in Dorsetshire ([51]), Buckinghamshire, Norfolk, and more especially in Suffolk. The practice of scarifying, has become so predominant in the strong land district of that county, from the fine tilth which it gives to the lands, that there is reason to believe, it will entirely exclude the application of the plough to heavy lands in spring. The management for this purpose is excellent. While the land is yet dry in autumn, the fields are carefully ploughed into ridges, exactly of the breadth which suits the various implements to be employed in the spring, such as harrows, scufflers, scarifiers, and drill machines, all adapted to one given breadth, so that no horse, when drawing any of them, may ever set a foot on the ridge, but move slowly in the furrows. This improvement is applicable to the broad-cast system, as well as to the drill; and it certainly removes the main objection, to the drilling of spring crops on strong lands ([52]).

Nor is this practice of scarifying for a spring crop, solely applicable to a winter furrow on strong lands, for it has likewise been tried, and most successfully, in autumn. Pea and bean stubbles have been scarified, and sown with drilled wheat, without any ploughing, and the crops have proved better than after the usual system ([53]). In late and rainy seasons, sowing wheat after beans is extremely precarious; but if this system uniformly answers, there is an end to that difficulty.

Some doubts are still entertained, whether, though the plan may succeed in regard to one crop, it may not injure the succeeding ones in the rotation. If that should be the case, it ought not to be persevered in. But from the best information that could be procured, in consequence of inquiries made expressly to ascertain that fact, there is no reason to apprehend, that the future crops will be thereby deteriorated ([54]).

Sect. IV.—*Of Harrowing.*

This process is of essential use in the culture of arable lands. By harrowing, the soil is pulverized;—root-weeds near the surface are torn out and collected, more especially during the operation of fallowing;—the manure that has been inserted in the soil, is more thoroughly mixed with it;—and the seed is more effectually covered (55). The large, or what are called the *brake* harrows, are of great use also, in the cultivation of rough land (56).

To answer so many various purposes, harrows of different dimensions, weight, and strength, have been invented, suitable to the strength and condition of the soil, and adapted to the particular purpose intended to be accomplished.

There are two modes of driving the harrows: either leading the horses, or driving them by whip-reins. The latter ought to be preferred, as the horses move with a quicker step, and the driver runs no risk of injury, while he is always at hand, to remove any obstructions that may occur, from the accumulation of weeds, and other extraneous substance among the tines, or by the harrows riding on each other (57).

Harrowing is usually performed in different directions; first in length, then across, and finally lengthwise as at first (58). An excess of harrowing is prejudicial to wheat; it is better, for that crop, to have the land rough and rather cloddy; but the process ought to be effectually done for barley, (more especially if accompanied by grass-seeds), and for turnips.

The quantity done, must vary according to the pace of the horses. In Norfolk, it is the custom to walk the horses against the rise, if any, and to trot them back again in the same place. The quantity done in this way, is about seven acres per day (59). In Scotland, a man and a pair of horses, will do a single *tine*, as it is called, to the extent of ten acres; but if a double tine, only five acres per day. The expense in the one case is 10¼d., and in the second 1s. 8d. per acre.

As the treading of horses is injurious to the land, when in wet condition, attempts have been made, to discover a mode of harrowing, which might be performed by horses walking in the furrows (60). But where the ridges are broad, such machines are complicated and expensive, though, with narrow ridges, they have succeeded; and this is one of the advantages which narrow ridges have over broad ones.

Sect. V.—*Of Rolling.*

An intelligent farmer maintains, that if draining is the first, manuring the second, and cultivation the third, rolling ought to be considered the fourth principal operation in the processes of agriculture ([61]). Its importance indeed, is every day becoming more apparent, and new advantages are derived from its use, both on arable, (to which the inquiry is now restricted), and on grass lands.

Without rolling, the process of summer-fallow, on strong land, cannot be completely executed; but by its aid, the strongest and most obdurate clods may be reduced, and the harrows and the scarifier are thus enabled, to tear out the roots of the couch grass, and of other destructive weeds. How much cheaper is rolling, than the old practice, of breaking such clods by wooden mallets, or by large three-pronged forks, as is practised in some parts of Flanders! To facilitate this process, rollers with spikes, and knives, (which are found more effectual), are sometimes used ([62]). Lord Kames recommended for that purpose, surrounding a wooden roller with circles of iron, six inches asunder, and seven inches deep, which would cut the most stubborn clods, and reduce them to pieces of a moderate size. In stiff clays, this may make the difference of a plentiful, or a scanty crop ([63]). Others prefer the *drill-roller*, consisting of solid, wedge-like rings of cast-iron, with a hole through them, to receive a stout wooden axis ([64]).

In preparing every species of adhesive soil, for a spring or summer crop, in particular when barley, potatoes, or turnips are to be sown, rolling is essential ([65]); but it is after the seed has been sown, that the greatest advantages are derived from the process. 1. Wheat should always be rolled in the spring, after frosts, as it makes the soil adhere more closely to the roots of the plants, encourages vegetation, strengthens the stems, and renders the grain more perfect. 2. When any crop of grain is sown with artificial grasses, rolling is particularly necessary, to make an even surface, bruising all clods, and pressing down any stones it may not be thought necessary to carry off, to facilitate the future operation of the scythe. 3. Oats, in a light soil, may be rolled with advantage, immediately after the seed is sown, unless the ground be so wet as to cling to the roller. 4. After turnips are sown in drills, they ought to be immediately rolled, to make the soil compact, and to promote their speedy germination ([66]). 5. Not only for turnips, but for all other crops, rolling, particularly a little after midnight, is found to be useful for destroying slugs ([67]), snails, the wire-worm, and other vermin, so destructive to young plants. And, 6. Flax ought to be rolled immediately after sowing, as that operation makes the seed vegetate equally, and prevents after-growth, the mischievous effects of which are visible in every step of the process for dressing flax.

The other advantages of rolling arable land are, that it renders a loose soil more compact and solid. This encourages the growth of plants, by pressing the soil to their roots. It likewise keeps in the moisture, and prevents drought from penetrating. When the soil is worked up lightly, moisture either filters through it too quickly, or is easily evaporated. In a dry season this may occasion a very material difference in the crop, more especially in a light soil.

Rolling is executed to most advantage, across the direction of the ridges, because more adapted to ensure full benefit to the furrows, which otherwise may not be properly gone over.

The heavy roller, allowing for a slight overlap, and the time spent in turning, may roll about six acres per day, the expense of which may be from 1s. 9d. to 2s. per acre.

Farmers are rarely provided with a sufficient number of these implements. 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 ([68]); and where oxen are kept, they may be usefully employed in this operation.

Sect. VI.—*Choice of Seed.*

Cultivators often commit very serious blunders in the choice of seed; yet by attention to this object, they might frequently add considerably to the quantity of the produce, and to the intrinsic value of the crop.

By some, the hazardous rule, of taking the worst grain for seed, has been recommended; but it is a much safer system, unless in cases of real necessity, to use none but what is fully ripened, for such seed is less affected by injurious local circumstances, or unfavourable seasons. The ripest seed may be obtained by beating, or slightly thrashing the sheaves.

The shape of the seed merits attention, for though size or magnitude is generally owing to the soil in which it has been grown, yet it is likewise a sign of its ripeness. In regard to figure, much depends upon the climate, for warm and early situations produce round grain; whereas a long figure denotes the reverse. Colour is a popular mark in some cases, but is not itself of importance. It is prudent, however, to raise that sort which is most suitable to the market, in regard to colour, and in other respects. Sometimes seed, apparently quite sound, is incapable of producing plants. This should be ascertained, by sowing a certain number, and seeing how they spring.

On the whole, though blighted grain will often vegetate, and though it is possible, that in rich soils, and in very favourable seasons, it may produce even an abundant harvest, yet the prudent farmer, will not rely *upon the chance of such an event*, as a practice on which he ought to depend, more especially when his crops are sown in winter, or early in spring, and consequently are exposed to much severity of weather ([69]).

Care also must be taken, that the seed has not suffered injury by being bruised, or having imperfect lobes, or broken husks, and that there is no risk of sterility from age ([70]).

Where domestic seed is relied on, it is proper to change the seed from the heavier, to the lighter parts of the farm, and *vice versa*, if there be much difference. On clay farms in general, domestic seed may be safely used for some time; but with a view to prevent degeneracy, it is an excellent practice, to select, from the growing crops, the ears which are the soonest ripe, and which are of the plumpest quality; by this means, those husbandmen who devote themselves in a peculiar manner to this object, can not only supply themselves, but can always command a much higher price than others, by selling the grain raised upon their farms for seed, either among their neighbours, or in other districts ([71]).

Sect. VII.—*Change of Seed.*

A change of seed, being founded on rational principles, is in general to be recommended. Every species of grain has a climate in which it flourishes, and a soil in which it never degenerates; for instance, in Sicily, where wheat is said to grow naturally, the seed that drops from the mother-plant, arrives at perfection, though neither the seed nor the soil be changed. But as wheat is not a native production of Britain, it has here a great tendency to degenerate, more especially in the northern districts; and *it degenerates rapidly*, if the seed be sown, year after year, in the neighbourhood where it was produced. Nor is it sufficient that the seed be procured from a different field; it ought also to be taken from a different soil, and a different atmosphere (72).

Besides preventing a degeneracy in the quality of the grain, a judicious change of seed, has a tendency to effect an earlier maturity in the crop; an object, in many cases, of the greatest moment. It is well known, that a change of constitution in plants, originating from the situation in which they have been placed, is commonly transmitted to their offspring. Plants propagated from seed produced in a warm sandy soil, will therefore grow quickly, in whatever soil the seed is sown; and plants from seed produced in a cold stiff soil, are late of growing, even in a warm soil. Hence the advantage of changing seed from a warm to a cold soil; for though seed from a warm soil, will not grow so fast in a cold, as in a warm soil, it will, however, always grow more quickly than seed from a cold soil (73). The quantity also will be increased. From an experiment made by the celebrated Lord Kames, it would appear, that the produce of changed seed, exceeds that of old seed, at the rate of nearly twenty-six per cent. (74). The farmer however, ought not to alter his seed, while it gives him fair and reasonable satisfaction, unless he has every reason to be convinced, that better can be obtained by a change.

It is proper to add, that in two cases it has been found expedient, to change the seed from an inferior to a superior climate. In Flanders, where great quantities of flax are grown, the seed must be brought from the Baltic, otherwise the crop will be deficient. In the case of potatoes also, seed is imported from an inferior climate, as the most likely means of preventing the disease called the *curl*. It has fortunately, however, been discovered, that by taking up potatoes for seed early or sowing them so late, that they cannot reach maturity, the same object may be obtained.

Besides changing seed, crossing different varieties has been found of use. Mr Knight has not only raised new varieties of apples, and of the garden pea, but has likewise tried experiments with crossing wheat, which he has effected by sowing the different kinds together. This was attended with a most extraordinary result; for when, in the year 1796, almost the whole crops of corn in the island were blighted, the varieties obtained by crossing, alone escaped, though sown in different soils, and in very different situations ([75]).

Sect. VIII.—*Quantity of Seed.*

It is hardly to be credited, how little this branch of the inquiry is attended to, or understood, in several districts. In some, the quantity of seed sown is enormous, as a quarter of oats or eight bushels per acre ([76]). In others, they sow the same quantity of wheat in all seasons of the year, without paying much regard to the time of sowing; though two, or three bushels of seed sown in August or September, are equal to four bushels and upwards, sown in the latter end of November, or in spring. Thick sowing must occasion a great deficiency in early sown wheats, in weak and shallow soils; for though they may be in heart sufficient to push a number of plants through the winter and spring, yet the vigour of the soil is spent in the earlier stages of vegetation: the straw is slender and scanty, and the ears abridged of half their load. Whereas, had there been only a due proportion of plants, the exhaustion, during winter and spring, would have been less severe, and the strength of the soil would have been reserved, for the more material purpose of perfecting the plants in harvest ([77]).

In treating of this subject, it may be proper to lay down, 1. The rules to be recommended respecting the quantity of seed in general; and, 2. The fittest proportions for the different crops.

General Rules.

1. The first point to be considered, is *the Climate.* In a district where a crop is likely to experience favourable seasons, a less quantity of seed will be required, than where it is liable to a succession of variable weather, and occasionally, to great storms of rain or snow, or to severe frosts. Indeed where the climate is uncertain, it is necessary to employ a sufficiency of seed to provide against accidents.

2. The nature of *the Soil,* and its state of fertility, are the next points to be discussed. On light thin soils, for the reasons already assigned, the quantity of seed ought to be moderate; whereas, in strong, stiff, wet, retentive soils, on the other hand, as the plants seldom branch off much

from the roots, a large proportion of seed will be necessary, in order to secure such abundant crops, as lands of this description are capable of supporting. But where such lands are well prepared, rendered friable by a summer fallow, and in high condition, a small quantity of seed is sufficient; for though the crop may appear thin during the winter, the seedling plants have time and vigour enough to fill up the field, by means of suckers, or lateral plants, which branch out from the principal root, and produce a full crop in autumn ([78]).

3. The next point for consideration, is, *the Season when the Seed is sown;* for it is evident, that seed sown early, takes deeper root, and has more time to branch out additional shoots, than that which is late sown. Hence a less quantity is sufficient. Indeed, with late sowing, the progress of the crop may be retarded by dry and hot weather, unless a large quantity of seed be employed, so as to afford protection to the soil from the mischiefs of evaporation, by the plants growing closely together. It seems to be a judicious rule, on soils of a medium quality, where wheat is sown broad-cast, to use about two bushels and a half per acre, towards the latter end of September, and to add a gallon of seed for every fortnight afterwards ([79]).

4. *The state of the Weather, when the Seed is put into the ground,* must likewise be considered; for where the season is very dry, and where there is a small proportion of moisture in the soil, more of the seed may fail to vegetate, than where the contrary is the case. Hence a larger quantity is required; and hence the propriety, not only of a larger quantity of seed, but the practice of steeping, and of putting in the seed in such dry seasons, immediately after the plough ([80]).

5. *The manner in which the Operation of Sowing* is carried on, it is obvious, must make some difference in the quantity sown. Where the broad-cast system is adopted, a larger quantity of seed is required, than where the grains are deposited, with equality, and exactness, only on certain portions of the land, as is the case in the drill and dibbling methods. Where the grain is scattered over the whole surface of the soil, in some measure at random, it is exposed to the depredation of birds, and some of the seeds may not be placed in a situation favourable to vegetation. At the same time, under the drill system, the saving of seed cannot be carried to any great extent, without the risk of disappointment ([81]), though it may in dibbling.

6. In regulating the quantity of seed, it is necessary also to have in view, *whether Clover is to be sown with the Grain;* for in that case, it is evident, that a smaller quantity of the grain seed ought to be used, otherwise the clover may be materially injured, by a superabundant crop of grain.

7. *The Quality of the Seed* is another point to be attended to; for it cannot be doubted, that a less quantity will be sufficient, when it is known to be good and perfect of its sort, than when from age, an unfavourable harvest, or otherwise, it is known to be the reverse. In the former case, every seed will vegetate, whereas, in the latter, many must prove defective.

8. The last point relates *to the Size of the Seed;* for the smaller the size, the greater number of plants will be produced from a certain weight of corn; and when the grain is round and plump, its being of moderate size, does not make it less fit for the purposes of vegetation ([82]).

Proportions of Seed for the different Crops.

It is to be regretted, that the proportions of seed best calculated to afford the fullest and most abundunt produce, in different crops, and under various circumstances, has not yet been decided by the aid of experimental investigation. The following hints, it is hoped, will throw some light on this branch of the subject.

Wheat.—When land is in high condition, and adapted for wheat, more especially after a summer-fallow, about two bushels per acre have been generally found sufficient, in the best cultivated districts of Scotland. Bean stubbles require more seed than summer-fallows, because the seed, from the roughness of the surface, cannot be so well distributed; and clover leys, ought to have more seed than even bean stubbles. Turnip land, sown with wheat in spring, must have a still more ample allowance, as the shorter period of growth does not leave a sufficient interval for tillering, and many of the suckers that are produced, never come to maturity. In these cases, from three bushels up to rather less than four, may be required ([83]). In England, it is calculated, that about two bushels and a half is the medium quantity of seed wheat throughout the kingdom ([84]), though it is often more.

Barley.—The quantity of seed for a crop of barley, varies from two bushels and a half, to four bushels per acre; but it is always safer to give too much, than too little seed. It is a rule indeed, with all spring-sown grain, to give a sufficient quantity of seed, to ensure a full crop from the first growth, and not to depend upon tillering, or planting out. With a full quantity of seed, the crop grows, and ripens equally, and, unless in very unfavourable seasons, the grain is uniformly good. Barley, being generally sown in the dry seasons of the year, the plants are often stunted in their growth, and unable to send out off-sets to stock the soil. The plant may afterwards stool or tiller at a later period; but these young shoots, cannot be expected to arrive at maturity, or if their ripening is waited for, there is a great risk of losing the first, or earlier growth of the crop ([85]).

Oats.—The quantity of seed for a crop of oats, is generally from four to five Winchester bushels per statute acre; though in Devonshire they go as far as six bushels, and in Yorkshire even eight ([86]). The amount must depend upon the richness of the soil, and the variety that is cultivated. The potatoe-oats, not having any tail-oat, like the ordinary sorts, and tillering well, require much less seed, in point of measure, than the other sorts; and may be safely trusted, when the land is equally well cultivated, with as small a quantity of seed as barley, namely, from two and a half to four bushels ([87]). It is, however, to be observed, that as oats, in general, are cultivated on weak and inferior soils, and in cold climates, the quantity of seed should be increased in proportion as these circumstances operate.

Beans.—In the culture of beans, different quantities of seed are used in England and Scotland. In the former, three bushels per acre are considered to be a sufficient quantity, if drilled, and four, when broad-cast; but in Scotland, four bushels are required when the beans are sown in drills, and five bushels when sown broad-cast. Perhaps this may be partly owing to the difference of climate, beans being sown early, and exposed to much severity of weather. Besides, it is maintained in Scotland, that unless the rows of beans close effectually over the land, weeds will unavoidably grow, and flourish, after the cleansing process is finished. The land will thence become foul, so as to defeat the very object of the drill husbandry, the crop will be proportionably injured, by being robbed of its nourishment, and the soil will be left in a wretched condition, compared to that in which it ought to have been placed ([88]).

Pease.—When drilled, four bushels of seed are considered to be sufficient, but when sown broad-cast, from four to five bushels are supposed to be necessary. Much, however, must depend upon the size of the pea, the luxuriance of its growth, and the peculiar qualities of the variety sown, for three bushels of the grey pea, as seed, are found equal to four of the white [89].

Clover and Rye-grass.—It is not advisable to sow at the same time, a mixture of light and heavy seeds, as clover, and rye-grass. It is impossible that it can be done correctly; and it is much more prudent, to go once over the ground, with each sort of seed. The usual quantity per statute acre, is from ten to twelve pounds of red clover seed, and about a half, or two-thirds of a bushel of clean and well-dressed rye-grass seed. If the rye-grass *is cut young*, it is not injurious to the soil.

On the whole, seed ought not to be distributed with too rigid economy, as a full crop of any grain whatever, is cheaply purchased, by giving a sufficiency of seed; while a scanty crop, besides being in itself unprofitable, is sure to poison the land, by facilitating the growth of weeds [90]. There is a happy medium, however, in this, as well as every thing else. For a crop may not succeed, when the plants are too numerous in the ground, any more than when they are too few. Their over-luxuriance may likewise be prejudicial, by retarding the ripening, and hazarding the safety of the crop [91].

Sect. IX.—*Preparing the Seed for Sowing.*

With a view of bettering the future crop, husbandmen have attempted, in various ways, by preparing the seed for semination, to accomplish four objects:—1. The discovery of weak or faulty seed;—2. The preservation of the seed from the attacks of vermin of various sorts;—3. The promoting of the germination and growth of the future plants;—and, 4. The prevention of certain disorders, to which they might otherwise be liable [92]. The fourth point shall be the subject of future discussion;—the other three shall be briefly considered in this place.

1. In order to detect and separate imperfect and disordered seeds, from those which are sound, and fit for sowing, it is only necessary, to pour the grain, gently, either into common water, or into a solution of salt and water. In this way, the imperfect and disordered seeds, from being lighter, are soon discovered; for they swim on the surface, and can easily be skimmed off, either when at first poured in, or every time the mass is stirred. Common water is in general con-

sidered to be sufficient; but the addition of salt is of use, by increasing the specific gravity of the liquor, and consequently bringing up grain, in a lesser degree deficient in weight. The solution should be made so strong that an egg will swim in it.

2. Steeping seed for its preservation against vermin, (as insects, birds, field-mice, &c.), is principally effected, by employing some article, as train oil [93], stale urine, &c., that has an offensive smell, and deters them from approaching it. For that purpose, the Romans used the lees of oil, decoctions of cypress-leaves, juice of house-leeks, &c. and they placed great dependence on the virtues of these applications. In modern times, saline and caustic particles are applied to the seed of barley and oats, as well as of wheat, to preserve it from the attacks of vermin, or to destroy such as may venture to eat it.

3. Attempts have also been made, to promote the germination, and the growth of plants, by steeping them in water, and other substances, with a view of securing in spring a few days' start in vegetation.

Some farmers have steeped barley in pure water, from 16 to 24 hours, if it is to be sown in light soils, where there is not a likelihood of sufficient moisture being in the land, to promote germination; and some accounts have been published, of considerable success attending that practice. It is very hazardous, however, to oversteep the seed, lest it should destroy the embryo plant; and it is recommended, to roll the soil afterwards, that the moisture in it may be retained. The application of dung-hill water, however, to seed-corn, seems to be still more useful [94], more especially if the urine of cows is made use of; but as it contains a great proportion of ammonia, no seed can be safely kept in it above an hour.

Gardeners frequently steep beans to accelerate their growth, and some farmers have found it of advantage, in late situations, to adopt this practice, to a considerable extent.

They have a practice in Switzerland, of steeping the seed of clover, in common oil, for an hour or two, to prevent the attacks of insects. It should then be mixed with powdered gypsum, to promote a rapid vegetation. The same plan might have similar effects on turnip seed, and prevent those risks to which the crop is liable in its early stages. Oil is peculiarly destructive to insects *when applied outwardly,* as it stops up the pores of the skin, by which their respiration is performed. When taken inwardly, it is not so injurious.

Sect. X.—*Season for Sowing.*

The period of sowing the different grains, varies so much, according to situation,—soil,—climate,—species,—and a number of other circumstances, that it is impossible to lay down any general rule, but this, "That early sowing is, on "the whole, to be recommended (95)." It has been found, by a number of accurate experiments, registered in Dr Hunter's Georgical Essays, that, in England, from the middle of September to the middle of October is the best time to sow wheat. It is true, that all farmers cannot complete their seeding within this time, but it is important, that they should attend to it as far as it is practicable.

On several accounts it is desirable, to sow before winter, or early in that season, to as great an extent as circumstances will admit of: 1. Because, when a good deal of work is over in winter, there is less to do in the spring;—2. Because, when the seed is sown in winter, a less quantity will suffice;—3. Because, the crop will be ripened earlier, which, in times of scarcity, may prevent the calamities of famine;—4. Because, when a crop is sooner ripe, it is less liable to disease in its progress, or to injury in time of harvest;—and, 5. Because, it may be possible to obtain a second crop in the course, even, of that year. This is frequently the case in Flanders, and even in England, where "*stubble turnips*," as they are called, are often raised.

On all these grounds, it is well entitled to the consideration of the farmers of Great Britain and Ireland, whether two sorts of grain, barley and oats, commonly sown in spring, may not, to *a certain extent*, be sown previous to winter.

In regard to barley, the two-rowed grain will not answer; but there can be little doubt that the four-rowed, or the six-rowed varieties, would succeed. The Flemish derive great advantage from the cultivation of *sucrion*, or winter barley, which they greatly prefer to the spring. It ripens earlier, is more productive (96), sells at a higher price, and yields a greater quantity of malt liquor, or spirits. A valuable crop of turnips may likewise be raised after it (97).

As to oats, autumnal sowing is strongly recommended by its success in Ireland. The plan is not calculated, however, for cold or poor soils; but in rich and fertile land, there can hardly be a doubt of its success. The oats should be sown in September, or the beginning of October. As the crop will tiller in the spring, about half the usual quantity of seed will be sufficient. This practice answers best in a dry soil; but where moisture is likely to be injurious to the crop, the furrows should be gone over by a plough, without a mould plate, and the mould or loosened earth, should be thrown, by spades or shovels, upon the land sown with the oats. If the crop is too luxuriant in spring, it may either be cut with the scythe, or fed off with sheep, in the months of February or March. This is of use to the crop, though it may retard the ripening. But after all, it will be a fortnight or three weeks earlier for the sickle, than the spring sown, and the produce will be more abundant. If possible, seed should be procured from a crop that had been sown in winter, as such oats will naturally produce plants of a hardier nature, than could be obtained from spring-sown corn. The Tartarian oat, as being of a sort peculiarly hardy, has been strongly recommended for trying the experiment ([98]).

Sect. XI.—*Sowing Broad-cast.*

The most advantageous mode of depositing seed in the ground, and of covering it afterwards, is one of the most interesting subjects of agricultural inquiry. It has of late attracted particular attention, and has been discussed, not only in various publications, but at numerous meetings of intelligent practical farmers. It may be considered under three heads.—1. Sowing broad-cast;—2. Drilling;—and, 3. Dibbling.

Sowing Broad-cast.—This mode of sowing, was originally almost universal. It is still very generally adopted in many districts in these kingdoms, and is the usual practice in the greater part of the Continent. To execute, however, the process well, is attended with much difficulty; nor is it possible, from any description, to form an idea, of the measured step, the regular handfuls, and the artificial cast which the sower acquires, and which can only be learnt, by inspection, imitation, and practice. A skilful and experienced sower, regulates the prescribed quantity of seed to the acre, with wonderful precision, and distributes the seed over the ground, with the most exact equality. It is often however, very imperfectly executed; and even where it is done well, it must depend upon the subsequent operation of harrowing, whether the seed is deposited at the proper depth, so as to germinate with advantage.

It is objected to this process, by those who have adopted a more correct one, that it is slovenly;—that it is difficult to conduct it properly in windy weather;—that the seed is placed at unequal depths;—that a very large proportion of it is either left but thinly covered, or is sunk too deep in the soil;—that a heavy loss must be sustained, from the quantity that is exposed to the attacks of birds, and to the injury that may be sustained from great droughts, or severe frosts;—and that unless skilfully done, a part of the ground may remain unoccupied.

Notwithstanding these objections, the broad-cast system has continued to prevail in various districts, not only on account of its simplicity, and its requiring less expensive machinery, but where the climate is unfavourable, or the seasons unusually backward, from the expedition with which it is executed, and the greater certainty of effecting the object in any season ([99]). Indeed, where the climate is unfavourable, any additional time and labour required, more especially during the seed process, are very important considerations to farmers. Their establishment of men and horses, (the heaviest of the charges on agriculture), is economically proportioned to the work of the whole circle of the year; and, independently of all other considerations, the sowing by the drill, requires more time than surface-sowing.

Instead of sowing broad-cast by the hand, machines for that purpose have been invented. By them, the corn is delivered with great regularity, from a horizontal trough, ten feet in length, by brushes, upon a turning axle, worked by the rotation of the wheel of the machine. The most improved kind has two wheels, and is drawn by a mule, or light horse, in shafts. A great saving of seed, and equable sowing, result from the use of this implement ([100]). Such machines are likely to be particularly useful for clover, and other small seeds, which are distributed, by the hand, with more difficulty.

After the seed has been deposited on the surface, there are two modes of covering it: 1. By the harrow; and 2. By the plough.

1. Harrows are of great use, not only for pulverising the soil, and clearing it of weeds, but also for covering the seed after it has been sown on the surface. Of late, the form of this implement has been greatly improved. Still, however, the seed cannot be so advantageously deposited as under the drill system.

2. In the greater part of England, where drilling does not prevail, the seed is not harrowed but *ploughed in, or covered by a furrow*. This is often done on light soils, by a light

one-horse plough, immediately after the seed is scattered over the surface. But in many of the heavy soils of England, the seedsman follows the plough, scattering the seed by hand, *in the trenches of each furrow,* as they are successively formed, (called *straining in,* or *spraining*), and on the return of the plough, the seed is covered with earth ([101]). As a preparation for this plan, the land is commonly fallowed, and cleared of weeds; it receives, where the process is properly conducted ([102]), five summer ploughings, the three first to the depth of seven inches, and the two last shallower, sufficient to bring into a completely pulverized state, a quantity of mould for covering the seed, as soon as it is deposited. The bottom contains from four to five inches of, comparatively, firmer texture; but yet considerably tempered, on which the seed may rest. It is thus inserted at a proper depth, and deposited on a bed, the most congenial that can be devised to promote germination, and the most favourable to its first efforts of growth. The substratum gives an admirable anchorage for the roots in the soil, and the fine earth by which it is covered, gives the least possible obstruction to its upward shoots. It is likewise protected from being root-shaken by frost, and from all those depredations, which are made upon seed sown on the surface, and afterwards merely harrowed. By this method of preparation, therefore, many advantages are obtained, and a crop so conducted, may reasonably be expected, to be both luxuriant in growth, and abundant in produce ([103]).

Some eminent agriculturists, are so partial to the system of ploughing in, that they think it ought to be generally practised, in preference to every other mode of sowing grain; and that owing to its not being adopted, thousands, and tens of thousands of bushels of grain, are annually lost to the country. But it is evident, that on very strong soils, there is some risk of caking, more especially when the crop is sown in autumn, and exposed to the winter rains;—that if unskilfully executed, there is some hazard of throwing too much earth on the seed, so as to prevent vegetation;—and that it requires nearly as much time and labour as drilling, though without its expensive machinery.

Sect. XII.—*On Drilling, or depositing the Seed in Lines.*

The system of drilling, or placing the seed of grain and other vegetables, in regular rows, by machines invented for that purpose, is no new discovery. It has been practised from time immemorial in the East Indies ([104]), and has likewise been long known in Spain ([105]). The introduction of that mode of sowing into this country, is justly attributed to the celebrated Tull, who founded it on the erroneous doctrine, that tillage, *even without manure*, would produce an endless succession of abundant crops. That theory is fortunately abandoned ; but the practice of drilling, being now established on sound principles, and sanctioned by experience, is progressively increasing, much to the advantage of the farmer.

In discussing the subject of drilling, it is necessary to make a distinction between *leguminous*, or green, and *culmiferous*, or grain crops.

Drilling Leguminous, or Green Crops.

There is no question, but that the culture in rows, is best calculated for them, because, 1. It carries off the extra moisture in wet soils ;—2. It exposes more surface to atmospheric influence, by which the soil is ameliorated ;—and 3. It gives an additional opportunity for the vegetation, and the destruction of weeds.

Beans should be drilled, not only on loamy soils, but even on strong and rich clays. When drilled, from the manner in which the plants grow, the pods are placed on the stem from the root upwards, and of course they must derive essential benefit, when filling, by the admission of air through the open space left between the drills. The soil is likewise meliorated by the hoeing, and weeds are effectually destroyed ([106]).

Drilling for turnips is likewise greatly to be preferred. The superior facility afforded by the drill culture, of simplifying and expediting hand-labour ;—the advantages of applying recent and moist manure directly to the seed ;—the more regular and correct adjustment of the number of plants to be left on a given space ;—and the more equal admission and circulation of air among the plants ; entitle the drill system to a decided preference ([107]).

Potatoes also, ought to be planted in rows by all farmers, whatever plan gardeners or cottagers, on small patches, may adopt. There ought to be a distance of from 24 to 30 or even 36 inches between each row, so that the fibres which nourish the plants, may not be disturbed by the hoeing, for if they are injured, the stems will be puny, and the bulbs few and small ([108]). Drilling is greatly preferable to dibbling potatoes, as appeared from an experiment, expressly made to ascertain the advantages of each mode of culture ([109]).

The drilling of carrots has not been found to answer in Suffolk; but it has succeeded in the experience of Mr Butterworth and others, in Scotland, and of M. Chateauvieux, in Switzerland, with very wide intervals. This useful plant, can thus be cultivated with profit, on soils where otherwise it would hardly be practicable;—the drills furnishing an artificial depth of soil, in which this root can be raised. Fourteen inches between the rows is recommended as the proper distance ([110]).

In regard to pease, whether sown with a mixture of beans, or not, drilling is to be preferred to the broad-cast system, though the hoeing is attended with difficulty, owing to the plant falling so early down upon the surface ([111]). The rows ought to be from 20 to 27 inches asunder, and the intervals repeatedly hand-hoed. Any weeds that may grow among the pease may be pulled up by hand. It has been found that pease, properly drilled, and carefully hoed, were at harvest, nearly as clean as the beds of a garden, and the produce, both of grain and of haulm, quite satisfactory; whereas the head-lands, which had been sown broad-cast, had a miserable crop of grain, thinly scattered among a multitude of annual weeds, and scarcely worth reaping ([112]).

As to tares, they are sometimes drilled, particularly when sown in spring ([113]); but broad-cast is the more general practice, when sown in autumn. When drilled, the rows should be fifteen inches apart; and in strong tenacious clays, this crop, when repeatedly hand-hoed, is said, in dry seasons, to be more profitable than beans ([114]).

Drilling Culmiferous or Corn Crops; with Observations on the Row Culture, for Crops of Grain.

The question, whether it is most expedient or profitable, to raise culmiferous crops, according to the broad-cast, or drilled system, has agitated the agricultural world for a number of years; and as it is a point, respecting which there still exists a great diversity of opinion, it may be proper here to detail the arguments on both sides, that the reader may be enabled to form a decided opinion, which ought generally to be preferred; and in what particular cases, either the row, or the broad-cast system of culture, ought to be adopted.

The arguments against drilling, are, 1. That it is not likely to be profitable on a small scale, on account of the expense of the machinery for the different operations of sowing, hoeing, &c.;—2. That these operations must often occasion delays, incompatible with the hurry of an extensive autumnal or spring sowing, at least in wet seasons, and on wet soils, however little it may be felt in dry seasons, and on dry soils;—3. That it is not so well calculated for steep lands (115);—and, 4. That the grain is more liable to be shaken by winds, and the harvest to be later on drilled fields, than on those which are sown broad-cast, and consequently, that it is not so well calculated for a windy and a northern climate.

Some other objections were formerly urged against drilling, which the recent improvements in the system have effectually removed. For instance, it was anciently the practice, *to earth up the plants*, the consequence of which was, that in rich soils, the vigour of the soil was exhausted on the stems or foliage, instead of the fruit; and though the straw was strong and abundant, the grain was often defective in quality, or greatly diminished in quantity; whereas, now, it is a maxim in the school of Holkham, "*That white straw crops will be injured, if earthed up upon any soil* (116)."

It is likewise urged, that it might not be practicable in many districts, to find a sufficient number of labourers to hoe the drills, were all the crops on a farm to be subjected to that process. But in the present state of the country, with an overflowing, and unemployed population, a new source of occupation to the peasantry would be most desirable, provided their employers were remunerated for the expenses they incurred (117);—and where there is a scarcity of male labourers, women and boys have, in many of the agricultural districts, as in Gloucestershire, been taught the art, and have been found most expert at hoeing.

It has further been urged, against the use of the drill machine, that where seed has been steeped, and encrusted with lime, as a preventive of the smut, the lime destroys the brushes, and impedes the regular delivery of the seed. But this objection is easily removed, by using *cups*, instead of brushes, or by steeping the seed in a solution of the sulphate of copper, in a manner to be afterwards described, in treating of the diseases of grain, (see the Addenda); and the seed, in that case, might be sown in a few hours after the solution has been applied, *without lime*, and with a certainty of preventing smut.

It is also contended, that the drill machine does not answer where the soil is too full of small stones, which may prevent the coulters from sinking to a proper depth, so that the seed may not be sufficiently covered, to produce an abundant crop; but Mr Wilkie of Wimpole maintains, that there is no difficulty in drilling stony land, provided a proper drill machine, called " *a lever drill*," is made use of. The levers can be " *weighted*" at pleasure, and thus will answer in almost any soil, however stony, because that sort of soil is generally loose below, and better to drill on than even heavy cloddy land. The seed also will stand a better chance of being covered.

The introduction of the drill system is, by many of the most distinguished agriculturists, considered to be the most important of all modern improvements, and to be well entitled to universal adoption. It is principally recommended on the following grounds: 1. That the broad-cast system is a less perfect, and a less economical mode of cultivation, than that of drilling, for the seed can neither be deposited in the soil, with the same exactness in regard to depth, regularity, or proportion ([118]), nor be so placed, that the crop can afterwards be improved in its progress to maturity ([119]);—2. That in light soils, drilling has the important advantage, of giving the grain *a good hold* of the ground, and of giving all the seed the same depth of soil ([120]), by which the frost is prevented from throwing out the plants in spring, or the wind from loosening the roots, after the stem gets high, or when the ear is filling;—3. That the plants of wheat in drills, protect each other through the winter, and hence, that a field in drills, will be more forward in spring, and sooner ready at harvest, than a field sown broad-cast;—4. That by the improved practices in drilling, the use of manures, (rape cake in particular), is both encouraged and economized, so as to diminish the quantity necessary, and to increase its powers, by bringing it into immediate contact with the plant ([121]); and that a heavy crop of drilled corn, where the weeds are thoroughly destroyed, will be found much less injurious to the fertility of the soil, though raised with less manure, than the same crop grown broad-cast, with a greater quantity of manure, but encumbered with weeds;—5. That it gives an opportunity for cleansing the ground, even when the crop is growing;—of completely extirpating annual weeds;—of checking the growth of root-weeds;—and of preventing weeds in general, from being injurious to the crop;—6. That if the land is not hoed, but hand-weeded, less damage will be done to the crop, by the weeder's feet passing *between* the rows of plants, than by *treading upon them*, as must inevitably be the case, when working promiscuously over the ground;—7. That the progress of the grain, after the scarifier has worked upon the soil, is attended with the most beneficial effects ([122]);—8. That drilling is peculiarly calculated *for inferior soils*, and brings their produce more nearly on a footing with that of fertile land, than could otherwise be obtained ([123]);—9. That the pulverization of the soil, between the rows of autumn or winter-sown wheat, is of the greatest benefit to the clover seeds sown in spring, and that the admission of air between the rows, is of use to the corn crops ([124]), as well as to the grass-seeds sown with it;—10. That drilled crops of white corn, from the greater strength of their straw, are less apt to lodge, or to be beaten down in wet seasons ([125]); and are much less subject to other casualties, in particular to the diseases to which wheat is unfortunately liable;—11. That the expense of cutting down a drilled crop in harvest, is uniformly less, than of one which is sown broad-cast, since three reapers will do as much work in the former case, as four in the latter ([126]);—12. That drilled crops are more equal in growth, and that in general they produce a cleaner, and more regular sample for the market;—13. That drilled crops can be harvested to more advantage, and sooner conveyed to the barn, or to the corn-yard, than if they had been produced under the broad-cast system, in which less attention is paid to the destruction of weeds;—and, 14. That drilling may be of use in regard to the grub, and other vermin, for that the hoeing in spring, the treading of the hoers, and the stirring of the soil by the hoes, must give a check to their depredations ([127]).

In regard to any saving of seed, which by some is considered an advantage, Mr Coke of Holkham is decidedly of opinion, that such an idea is founded on erroneous principles, and that any economy of that sort ought not to be attempted ([128]). It is indeed of use to have the roots matted together, provided that there is substance enough in the soil to nourish the plants; and it is found, that wheat thrives best on a firm and compact bottom, which prevents the roots from being long and straggling.

Innumerable instances might be brought forward, of heavy crops having been produced under the drill system, by those who have bestowed much care in trying the experiment; and it has often answered, even on a great scale, when properly executed ([129]). But its success must depend upon the intelligence, attention, perseverance and capital of the farmer.

As it has been carried to the highest perfection, and cultivated to the greatest extent, on the farm and on the estates of that distinguished agriculturist, Mr Coke of Holkham, it may be proper to give a short account of his practice. He uses the Rev. Mr Cooke's drill, which is drawn by a single horse, and sows six rows at a time, and an acre in an hour. His wheat he sows at nine inches asunder, his barley at six inches three quarters. The quantity of seed which he sows per acre, is three bushels of barley, and six of oats ([130]). In regard to wheat, the average quantity which he prefers, is four bushels per acre. By depositing such a quantity of seed, there is no occasion to earth up the plants, for the sake of promoting tillering ([131]). On rich soils, it is the practice, to draw the drills from north to south, because the rays of the sun, when in his greatest altitude, striking directly between the rows of corn, have a powerful effect in strengthening the straw, and by absorbing the damp from the earth, become a powerful auxiliary in preventing mildew. On poor soils, on the other hand, the lines should be drawn from east to west, if the nature of the ground will admit of that plan being followed. Cooke's fixed drill-harrow, is used once in spring, the hand-hoe is used twice, the land is cleared of weeds, but the soil is not earthed up, nor accumulated against the corn. The hoeings cost about twentypence each, per acre. The largeness of the crops, particularly of barley ([132]), and oats, raised even on poor land, under this system, is hardly to be credited ([133]); and they are sometimes also of a superior quality ([134]).

A great improvement has recently been made in drilling, by the introduction of "The Inverted Hoes," invented by Mr Blaikie ([135]). They consist of a pair of blades, for each interval, going one before the other, and each having *the heel* turned to the row. This disposition of the blades prevents, 1. *Cutting the plants, or their roots ;*—2. *Moulding up ;* —and, 3. *Clogging.* They may be used, though the rows of corn are only nine inches distant from each other ; and it is found, that the occasional trampling of the horse on the young plants, is not attended with injurious consequences ([136]).

It was formerly believed, that drilling was only applicable to light soils ; but in Suffolk, strong or heavy land is now cultivated for spring crops, in drills, in a most perfect manner. The ridges are all carefully ploughed in autumn, or early in winter, to *the exact breadth*, which suits either one movement of the drill machine, or two. In the spring, the land is only scarified or harrowed, as it has been rendered thoroughly friable by the winter's frost, and the corn is drilled, without a horse's foot treading any where, except in the furrows between the ridges ([137]). Unless this practice is adopted, it would be difficult, in very wet seasons, to carry on the operations of the drill system, on heavy soils, with the regularity and exactness that are necessary ([138]).

In other parts of England, as in Kent and Hertfordshire, the drilling of strong lands is practised, for winter as well as spring crops; and Mr Childe, in Shropshire, drills all his crops, on the most adhesive clay, and in a hilly country, with the greatest success.

The propriety of drilling in Scotland, shall be discussed in the Appendix, as, owing to the peculiarities of the soils and climate of that country, it is necessary to enter more into detail, than with reference to England.

Besides drilling, &c. as above described, there are other modes by which grain can be cultivated *in rows*. Sometimes, by means of a drill-roller, a number of ruts are made at the distance of from eight to ten inches apart, over the whole of which, the seed is sown broad-cast, and swept into the hollows by a brush-harrow. In this way wheat has been raised on light lands, where otherwise it would have been impracticable ([139]).

There is another mode of cultivating wheat in rows, called "*ribbing*" ([140]), which is much practised in Northumberland. As soon as the ground is properly prepared, it is made up into small ribs, by a single-horse plough. The seed is then sown broad-cast among the ribs, or a person with a barrow-drill, goes along every rib, and drops the seed along the bottom, which is covered by a light harrow, drawn straight up and down the ridge. In either case, the plant makes its appearance nearly at the same time above ground; nor is there any difference, in this respect, between the two systems. The mode of ribbing is a simpler process than that of drilling; it may be executed in worse weather; the expense of a drilling machine is saved; and the crop may have all the advantages of hoeing, as if it had been drilled ([141]). But it does not suit all soils and rotations, or previous crops; for instance, strong clayey soils cannot be sufficiently pulverized for that purpose, nor can ribbing be successfully adopted with clover ley, unless it be twice ploughed, and thoroughly harrowed.

To those however, who are accustomed to *plough-in* their seed, the drill barrow, either attached to the plough, or following it in the furrow, pushed on by a boy ([142]), WOULD AT ONCE ESTABLISH THE ROW-CULTURE, WITHOUT DIFFICULTY, AND WITH LITTLE EXPENSE, OVER AN EXTENSIVE TRACT OF CULTIVATED LAND IN ENGLAND. The advantage of this simple improvement, can hardly be sufficiently appreciated. *Annual* weeds would be extirpated, and root weeds checked; and without dwelling on the immediate advantages of the system, the observation is perfectly well founded "were it even admitted, that drilled crops are not at first superior to the broad-cast, (the contrary of which has been found in numerous instances), yet in a succession of years, the progressive effects of constant hoeing, will render the drilled ones greatly superior ([143])."

The cultivation of culmiferous crops *in rows*, may therefore be justly accounted, the best method hitherto known, of raising crops of corn; and by promoting at the same time, the destruction of weeds, of preserving the fertility of the soil.

It is an additional reason for recommending drilling, that it would lead to habits of accuracy and neatness, in all the other branches of arable culture; whereas broad-cast sowing, encourages those slovenly practices, which still prevail but too generally in farming concerns. There is every reason indeed to believe, that the system would become general, were it once admitted to be *an established maxim*, (which the information above detailed sufficiently justifies), that drilling corn, like drilling turnips, is superior to broad-cast. Farmers would then prepare for it, by furnishing themselves with the necessary implements, and by dressing and cleansing the soil, with peculiar and minute attention. There might still be some exceptions, as on very strong clays, or in very unfavourable seasons; but these exceptions, as in the case of drilling turnips, would become every day less numerous. Our fields would then be cultivated with the same regularity and neatness as our gardens, and would become equally productive.

On the whole, such is the importance of the drill system, that its general adoption ought to be promoted as far as is practicable. Models or engravings of the simplest, and best machines, and directions for their use, ought every where to be circulated, and liberal encouragement given to those, who will prove, by accurate experiments, in districts where it is at present either entirely unknown, or but little practised, the utility of the system, and the profit to be derived from it. By the extension of drilling, inferior soils might soon be rendered nearly as productive as those naturally more fertile. In many cases also, by the introduction of this system, naked fallows might be abolished, where at present they are unnecessarily practised; and by these means, a treasure of solid and permanent wealth, in useful and valuable produce, might be rapidly spread, over the whole surface of the country ([144]).

Sect. XIII.—*Dibbling.*

This process has been already described, Chap. II. Sect. 7. Its recommendations are, 1. That only one ploughing is necessary;—2. That the seed is regularly deposited in the heart of the flag, where it feeds on the vegetable matter turned underneath, without any assistance from the subsoil;—3. That in common with the other branches of row culture, it may receive all the advantages of hoeing;—4. That there is a great saving of human food, from the smaller quantity of seed used ([145]);—5. That it furnishes young labourers with employment, and thereby inures them to industry;—and, 6. That the treading of the labourers employed in the operation, is favourable to production *in light soils.* It is certainly an advantageous mode of planting wheat, upon a one year's layer, on light and moderately deep soils; but it never can become a general practice in other cases ([146]). In tenacious soils, dibbling does not answer, as the dibble forms a cup for the water, in which the seed perishes ([147]). It likewise occasions more expense than any other process of semination;—and owing to the greater hurry and fatigue of the children employed in it, and sometimes from a desire of making higher earnings, is often imperfectly performed, without any great risk of detection. Nor can it ever be extensively carried on, unless where the population is very considerable.

The dibbling of pease has been practised from time immemorial in Norfolk; and the dibbling of beans is not uncommon in that county, and several other parts of England ([148]). In Middlesex, the beans are all dibbled in rows, and the pease are put in by hand-hoes ([149]).

Sect. XIV.—*Transplanting.*

This mode of propagating grain, though long known in the philosophic world ([150]), has not hitherto attracted the attention of the practical farmer; yet, in this way, a wonderful increase of produce may be procured.

This mode of propagating grain, should be kept in view on two accounts; first, that any valuable species of wheat or other grain, might be more rapidly increased; and, secondly, in case of any *very great scarcity*, transplanting would be by far the most effectual means of saving seed-corn. Besides, though it may not become a general practice, yet in cases where the ground is not regularly covered, a farmer may always find some places in his fields, whence plants may be drawn, without doing any injury; and the crops may thus be rendered, not only more regular and uniform, but also more abundant, and of a better quality, than where the vacancies are filled with spring wheat ([151]).

The experiments tried by Mr Falla of Gateshead, near Newcastle, in Northumberland, by which spade cultivation is united to transplanting crops of wheat, are highly satisfactory. The length of the plants, and the size of the heads, astonished every person who saw them, and the produce was at the rate of sixty-eight bushels per statute acre, though from five to six bushels were lost, from the crop being shaken by the wind, and preyed on by the birds. By this plan, numbers of the unemployed poor might be provided with work, and enabled to procure subsistence.

The transplanting of the Swedish turnip, is a practice, which has succeeded in Cheshire, Derbyshire, and Herefordshire, and is found to answer, both for cleaning the crop more perfectly, and raising a greater produce. The seed is sown in the latter end of April, in a garden. If the weather be favourable, the turnips are ready to be transplanted early in June; sometimes, however, it is protracted, owing to the season, until the middle or end of July. The land is manured, and prepared, as if for drilled turnips; and the plants are set from twelve to eighteen inches apart in the row: the greater the distance, the weightier in general is the crop. The transplanted Swedes, are afterwards treated in the same manner as the common drilled. When transplanted, it is of use to dip the roots in dung-water. The produce is from 20 to about 30 tons per statute acre. But it has been remarked, that though transplanting might have been expedient when the seed was scarce, the practice has become less necessary, since the seed has become more abundant; and that a crop of Swedes, raised from the seed, and not transplanted, often exceeds 30 ton per statute acre.

Sect. XV.—*On Hoeing.*

This is a mode of tillage, which is performed during the growth of a cultivated crop, and its object is, both to improve the present crop, and to prepare the ground for the succeeding ones. It is certainly of much use by breaking up the surface, if it has become encrusted;—by promoting the admission of air, and of moisture into the soil;—by improving its texture;—by preparing it for the reception of grass-seeds;—and by counteracting that tendency to weeds, in all tilled and corn-bearing ground, which, from their prevalence in the country around, or from their seed-roots lodging in the soil itself, must be as invariable as the return of the year. This process however, can never supersede the necessity of thorough fallowing, where root-weeds greatly abound ([152]).

Tull, and his disciples, considered hoeing, as more beneficial than common tillage. They contended, that land, when cultivated by the plough, soon begins to coalesce, whereas hoeing, always keeps it in a loose and pulverised state; that by hoeing the plants are kept moist, even in dry weather, their roots being nourished, by the dews which are absorbed, in proportion to the fineness of the soil; and that plants, which would flourish and grow strong in fine ground, are starved, if the soil is hard and crusty ([153]).

It is now however ascertained, that hoeing is a process, which, in moderation, is useful, but which is hazardous, if carried to an extreme. It is of use, when plants are young, for the reasons above detailed; and if, in the course of the operation, the roots of the plant are injured or destroyed, there is vigour enough in it, *when young*, to replace what has been lost, and to repair the mischief. But if the hoeing takes place when the crop is more advanced, the new roots are less efficient, the growth of the plant is hardly perceptible, the increase of bulk is slow, and the ripening becomes irregular. This brought drilling into disrepute, while hoeing was indiscriminately practised; and hence the opinion delivered by the late celebrated Arthur Young, "That those "who have made careful experiments, have determined, "that equidistant drilling, *hoeing only while the plants are* "*young*, is superior to broad-cast ([154])."

In cases where it is necessary to employ the hoe for the destruction of weeds, when the crop is more advanced, the earth should be moved at a greater distance than in the first instance; and in all cases it is necessary to be cautious, in regard to hoeing rich soils, otherwise the crop will be apt to rise in a weak state; if heavy rains take place, it will be lodged, the quality will be inferior, and the quantity considerably less.

Sect. XVI.—*Of Treading.*

After the seed is sown, treading the surface, is a practice that has been strongly recommended *on light soils* ([155]).

In some districts of England, it is usual either to fold the sheep on the ground sown with wheat, between the sowing and the coming up of the crop, or to drive the flock repeatedly over it, at that juncture; in order to give firmness to the soil, and greater stability to the crop. By this means, wheat may be raised on land, which is naturally too loose in its texture, for the profitable production of wheat ([156]).

Some farmers, on light soils, prefer pigs for that purpose, as better calculated for the process than any other animal, from their great weight, compared to the size of their feet ([157]). But in West Sussex, the lighter soils, in dry seasons, *are trod by the plough horses*, when turning the seed-furrow. Three plough horses, instead of going at length, draw the last made plough furrow a-breast, and thereby tread or compress the line of soil they are turning ([158]).

The advantages of treading, as more effectual than even rolling, in destroying the larvæ of insects, and preventing the harbouring of vermin in the soil ([159]), cannot be questioned. It may likewise contribute to check the vegetation of weeds;—it prevents evaporation;—and it is found, that the crops on land thus trodden, are not liable to be rusted. It is certainly most applicable to dry light soils; but even in wet ones, when it is impossible to roll the land after it is sown, owing to the wetness of the season, it may be trodden afterwards by sheep.

The discovery of a machine to facilitate the operation of treading, would be of immense importance to agriculture.

Sect. XVII.—*Of the Culture of growing Crops.*

Where husbandry is either imperfectly known, or carelessly practised, farmers are too apt to leave their crops almost totally neglected, from the time when they are sown, until the harvest commences. Any mark of their attention, principally consists in pulling up docks, or cutting down any thistles that make a prominent appearance, as they know well, that if they were left in the ground, they would render the harvesting more difficult and expensive; but where the drill system does not exist, careful weeding is by no means so general as it ought to be (160).

In Essex, the greatest pains are bestowed on hand-hoeing wheat. Five shillings per acre, are very generally expended; 20s. are not uncommon; and sometimes the expense reaches L.1 : 11 : 6 (161), and even more. The operation is frequently done twice, and occasionally thrice, when necessary. The hoes are powerful, and make a great impression upon the ground. The plants at first look sickly after it; but they soon recover, and are greatly improved by the operation. If executed too late, drought gets access, and does evident mischief; but if executed early, and especially where the plants are thin, it is very beneficial, thickening and improving the crop in a considerable degree (162).

The process of hand-hoeing broad-cast crops of wheat, is likewise conducted in Gloucestershire, with great attention and success. In the Vale, and forest districts in particular, few farmers hoe less than twice, at an expense of 7s. 6d. per acre. The first hoeing is begun as soon as the weather permits in April; the second follows soon after, and must be completed before the crop tillers, otherwise the stalk will be exposed to injury, and liable to be bent or broken. The hoes are in general from five to six inches in the plate, and have the corners rounded off. It requires much attention, and a quick eye, to stir the surface well, and to avoid destroying too many plants, as well as to leave the rest at proper distances; and this must be ascertained by the nature of the crop, and the fertility of the soil. If the plants are left to crowd each other, the heads will be small; on the other hand, should a greater distance be left, than at first sight may seem desirable, if the land is in good condition, the heads of the plants will be larger and more productive. On an average, a space about six inches between the plants, is thought sufficient. The advantages of this practice are great, the weeds which infest arable lands, are generally luxuriant in their growth, and unless checked in their early state, get the better of the more valuable plants that are near them; or, where they are of the creeping sort, they exhaust the nutritious particles in the soil, and by covering the ground, keep up a kind of stagnant moisture on the surface, at the same time excluding atmospheric influence, and the animating influence of the sun. The effect of this attention to the destruction of weeds, is experienced in the produce, the return being from 20 to 30, and on high conditioned lands, 40 bushels of wheat per acre ([163]), a considerable proportion of which is attributed to the crops being so carefully hoed.

This practice has been deservedly celebrated. In general, crops remain in a state of neglect from seed-time to harvest, whereas, in the Vale of Gloucester, the business of the arable process, does not seem to be set about in earnest, until the crops get above ground. By means of this attention to the crops *while vegetating*, many extensive common fields in Gloucestershire, have been cropped year after year, from time immemorial, without the intervention of a fallow; and thence have obtained the name of ‘ Every Year's Land.’ It is a maxim in this district, however, that pulse and corn shall be grown alternately. The hoeing is chiefly performed by women and children, industry is encouraged, the poor-rates kept down; and both the farmer and the public are essentially benefited by the process ([164]).

When a dry spring, succeeds a wet winter, the surface of strong land is often rendered so hard, and crusted, as to exclude the air, and, by confining the seed, to prevent the due evolution of its parts. The roots of the corn, being unable to penetrate freely into the soil, the wheat assumes a yellow and sickly appearance;—a diseased state, which may, and ought to be cured, by harrowing the wheat moderately, and immediately rolling it ([165]).

Another useful practice, during the process of vegetation, and which is extensively practised in various parts of England, is that of top-dressing the growing crop, when it is suspected that the land is not rich enough to bring a full crop to perfection. This should be done early in the spring, when the land is sufficiently dry to bear the treading of horses, without poaching. After the manure has been applied, the land should generally be harrowed and rolled. Soot, ashes, and other light manures, are thus most advantageously made use of.

Sheep are variously employed during the process of vegetation. In some parts of England, they are turned into crops of beans, to devour the weeds, and they leave the beans untouched. They are frequently folded on fresh sown wheat, which requires treading ([166]). When the crop is likely to suffer from the grub or wire-worm, turnips are spread upon the surface, and a flock of sheep brought to eat them, by which the vermin have been destroyed ([167]). When the crowns of the roots of wheat are exposed in the spring, two or three inches in length above the mould, the treading of sheep, after a moderate shower, will frequently force the wheat into the moist ground, where it will produce fresh roots ([168]). To check the luxuriance of winter-proud wheat, it is often fed in spring; but that plan ought not to be continued later than April ([169]). Ewes and lambs are too apt to reject the outer leaves, and, by eating the tender blades out of the hearts of the plants, frequently do great injury to the crop. Young cattle, on the other hand, benefit the crop, if they are not turned upon tender land, when it is wet and poachy, as they are satisfied with the coarser blades. In France, they feed their cattle in spring, on their young wheats, without any injury to the crop; and sometimes, when the crop is over luxuriant, the scythe or the sickle is applied.

Culture of Beans while growing.

A circumstance of great importance, with regard to the management of beans, has recently become the subject of much discussion, and may prove highly useful to the cultivator of that crop. It is well known, that beans are an excellent preparation for wheat; but it was often so late, before the crop could be cut down, and carried to the stack-yard, that the season for sowing the succeeding crop to advantage was lost. The injury thence likely to be incurred may be diminished, if not entirely prevented, by a simple expedient.

It has long been a practice with gardeners, to cut off the tops of beans, in order to accelerate their podding. From its success in the garden, it was natural to suppose, that it would answer in the fields; and some experiments were made in different places, to ascertain that fact ([170]). It was never, however, much attended to; and as it has probably been tried on the greatest scale, by John Lowther, Esq. Member for Cumberland, it may be proper to give the following account, of the origin and progress of the system, on his farm, as communicated to the Author.

His bailiff, George Lane, who had been a gardener, was instrumental in applying the garden culture of beans, to that of the field, and indeed the practice of cutting off their tops originated with him. It was begun about the year 1804, and has already been pretty extensively practised. The operation is performed by means of a sharp-edged instrument or knife, 12 or 14 inches long, exclusive of the handle; but it may be done by a sickle or reaping-hook, or a pair of light two-handed scissors, resembling those used in dressing hedges. The expense is stated at 3s. per acre, and may be contracted for at that rate. At a certain stage of its growth, the head of the bean-stalk, does not seem essential for the purposes of vegetation, but tends by its luxuriance, to exhaust the strength of the plant. The proper time to cut off the top is, when the first blossoms begin to drop; if done sooner, a fresh shoot will be put forth. As soon as the tops are cut off, the pods rapidly increase in size, and the period of ripening is accelerated. The timely removal of those parts where the insects chiefly lodge, materially contributes to the health and vigour of the plant, and probably increases the weight of the crop. The harvest is by this means also advanced *at least* a fortnight ([171]). In the ordinary mode of managing a bean crop, the tops are green when reaped, consequently they absorb and retain moisture, and require a considerable exposure in the field, to prepare them for the stack; whereas, without their tops, the crop is sooner in a condition to be carried, and less risk is incurred, from the effects of frost and wet seasons. The tops are left to rot upon the ground. The loss of some fodder and the trifling expense, are the only objections that can be urged against the practice. It is peculiarly calculated for the drill system, all the plants not being otherwise accessible; and it furnishes an additional reason, in support of that superior mode of culture for pulse crops.

In the General Report of Scotland ([172]), in which this process is briefly noticed, an old scythe-blade, set in a wooden handle, is recommended; and the expense is only estimated at about one shilling per acre; but even a much greater expense is not to be put in competition with the advantage of having the crop ready for the sickle, a fortnight earlier, and perhaps an additional week gained in the drying of the sheaves. Where reaping-hooks are in use, this operation may be easily and accurately performed by that implement.

The other improvements to be afterwards detailed, in the reaping and the harvesting of beans, in addition to their being drilled, have brought the culture of that plant to such perfection, as to render it a much more advantageous preparation for wheat, than it has hitherto been considered.

Sect. XVIII.—*Of Reaping.*

Experienced husbandmen think, that wheat should be cut down some days before it is *dead ripe* [173], for the grain hardens well in the sheaf, and the sample is often better. The harvest thus begins earlier, and its labours are more equally distributed [174].

Barley ought likewise to be cut before it is too ripe, otherwise the straw becomes brittle, which occasions much loss by the heads breaking off.

Though oats are reckoned a hardy grain, yet the more early varieties, are liable to damage from high winds, or from exposure to much wet, and ought to be cut as soon as they are nearly ripe, in order to lessen the risks to which they are exposed [175]. The advantage of cutting early, was experienced in Scotland by those farmers who cut down their crops greener than usual in the dismal years of 1782 and 1783, and cannot be too strongly recommended in unfavourable seasons [176].

Beans should be cut down, as soon as the eye has attained a deep colour, and if the weather be dry, made up as soon as possible, into sheaves. The straw will thus be of triple value, and the grain of superior quality [177].

Where the crop is lodged, whatever may be the state of ripeness, it should be immediately cut down; more especially if grass-seeds have been sown with it, which may otherwise be lost [178].

The nature of the instruments for cutting down the crops is the next point to be considered [179].

Various plans have been devised for that purpose, as, reaping by a sickle, or reaping-hook;—mowing by a scythe;—and *bagging.* The plan of cutting down corn by machinery, though it has made some progress, has not yet been brought beyond the line of partial experiment.

1. *Reaping by the Sickle, or Reaping-Hook.*

For districts in which a sufficient number of hands can be procured, reaping, either by the sickle, or the reaping-hook, are excellent modes of cutting down the crop, if attention is paid to low cutting. With careful reapers, there is very little waste;—the heads of the corn are all put in regular order;—and the crop placed in a position favourable to being thrashed, either by the flail, or by machinery.

Sickles are jagged on the edge with teeth; but reaping-hooks are ground sharp and smooth. The former is preferred in those districts where the practice of *bagging*, (to be afterwards explained), has not been introduced. The toothed sickle, requires but little sharpening;—it has the advantage of keeping the corn better together;—and in careless hands, some of the heads are cut off and lost, in using the sharp reaping-hook, when it enters among the crop, before the reaper has gathered the corn with his hand (180).

Reaping by the sickle is performed by the day;—by the acre;—by the harvest season;—or by the work that is executed, for instance, a certain sum for any given number of sheaves. Of these modes, the one *per acre* is the most advantageous, where the practice can be introduced.

It is a most essential object, to cut the crop very low, that any waste of straw, or loss of grain may be prevented. The additional quantity of grain thus procured, will pay the expense, and the increased quantity of dung, is mostly clear profit; because mowing the stubbles afterwards, imperfectly supplies the place of close cutting in the first instance.

Cutting corn when wet, ought to be avoided, for when put up in a damp state, in a close sheaf, it cannot get dry. In bad harvests, the sheaves ought to be *gaited*, that is, set up single, loosely tied near the ear-ends of the straw, and spread out circularly on their *butts*, or ends, to give them a firm standing.

The sheaves ought to be of a moderate size, with ordinary crops, not exceeding nine inches in diameter, or thirty inches in circumference; but when the corn is long, it will not stand well in the stacks, unless the sheaves are about a foot in diameter, and when gaited, every sheaf should be at least sixteen inches in thickness. In wet seasons, from six to eight inches in diameter is quite enough, and instead of binding with two lengths of the corn made into a rope, one is sufficient; nor ought the knee to be applied, when the sheaf is bound, as the air is thereby too much excluded. The binder's arm, will compress the sheaf as much as it ought to be, provided the size be such as is here recommended (181).

It is calculated, that three good reapers will cut down an English acre, and that one man will bind, and put into shocks or *stooks*, two acres per day. The expense of these operations, varies from 10s. to 16s. per English acre. Taking all charges into consideration, if the crop be good, and the reaping process be duly executed, the farmer has no reason to be dissatisfied, if he can get it done for about 15s. per statute acre.

2. *Mowing by the Scythe.*

This instrument is frequently made use of for cutting oats and barley; and in some districts of Kent and Norfolk, it is even used for wheat; but it does not answer, when the land is foul ([182]). The scythe is either plain, or furnished with a bow, or cradle, to assist in laying the heads more regularly in one direction. The late celebrated George Culley maintained, that this was the most complete mode of cutting down barley; that when properly mown, it could be neatly tied up in sheaves, and could be thrashed by a machine, though not so completely as if in sheaves. Whenever the crop however, is much lodged, or irregularly broken down, or interwoven by squalls of wind, or heavy rains, the scythe cannot act with efficacy, or even with safety. The use of the scythe therefore, is only admissible, when the corn stands upright, or with a regular inclination, or nearly so, in one direction ([183]). But the use of the scythe is objected to on the following grounds: 1. When clover, or any other grass, has been sown with the crop of corn, the scythe will cut nearly all the grass that has grown, which, mingled with the stems of the corn, in so large a proportion, must render the harvesting extremely hazardous. 2. It has a more slovenly appearance in the field. 3. It is more difficult, with a load of grass, to put the crop in shocks, or stooks, and the operation is more wasteful. 4. The crop cannot be so easily, or so safely stacked. 5. It requires more time in carrying, and greater space for housing than reaped corn; and, 6. It cannot be well thrashed by the flail, and it requires a good machine to thrash mown wheat clean.

A comparison has been made, between the expense of reaping by the sickle, and cutting down by the scythe. By the sickle, it would cost about 12s. per English acre, for barley, and 15s. for wheat. By the scythe, it could be cut down at least 2s. cheaper, and with from two to four additional inches of straw, the manure from which will be worth from 4s. to 7s. ([184]). It may be added however, that it is practicable to obtain nearly as much straw, by the sickle, as by the scythe, provided the farmer is disposed to bestow the necessary time and attention upon the conduct of his reapers, and will give them a moderate addition to their wages, when the work is properly executed.

3. *Bagging.*

This is a practice, principally confined to the counties of Middlesex and Surrey, where it has been adopted, with a view of securing an increased quantity of straw. This it does, to the amount of from 4s. to 7s. per acre. In Devonshire, the crops are chopped down, in a similar manner, so as to leave hardly any stubble ([185]). It is done by a toothless reaping hook, of about twice the weight of a common sickle, which is sharpened as often as is necessary. The operation is performed by cutting the crop down by a succession of blows, made within two or three inches of the ground. It is, in fact, mowing with one hand, against the standing corn. By bagging, the straw is cut much closer to the ground, than is generally done by hand-reaping ([186]). There is little or no difference of expense between bagging and common sickle reaping, whilst it is equally expeditious. Beans are usually *bagged* as well as wheat. The expense of bagging, is generally about fifteen shillings per acre; but it varies from twelve to twenty shillings, according to the bulk and condition of the crop ([187]).

It would appear, that the mode of reaping, as executed by Welsh labourers, in the counties of Hereford and Salop, is the most perfect, and the cheapest, of perhaps any hitherto known. It is performed by an instrument, a little longer than the common sickle, and about double the breadth, without teeth, but sharpened like a scythe. This sickle is known by the name of the *Cardigan hook*, which may be purchased at Ludlow, and all other towns in that neighbourhood, for 2s. 8d. each. With the hook, a whetstone is bought for 3d. This mode of reaping is equally applicable to wheat, barley, oats, beans, and pease. The reaper, bears up what he cuts against the standing corn, with one arm and leg, pushing it before him, until he gets about half a sheaf. It is cut down close to the ground. In the harvest of 1818, the common price given, was 4s. 6d. per statute acre, the employer finding food, drink and lodging; but when these are not furnished, the usual price is, from seven to eight shillings per acre for wheat; and for that sum, the reaper not only cuts, but binds up the grain. The general adoption of so useful a system cannot be too much recommended ([188]).

The Flemish mode of cutting grain, by a stick with an iron hook, and a short scythe, has been already described ([189]).

It is only a small deviation from bagging, and is said to be a most expeditious mode of cutting grain.

Sheaf Bands.

In the isle of Thanet, farmers prepare at their leisure, bands of straw, with knots at each end, which are carried by children to the field, and given to the workmen when wanted, for tying up the corn. Where there is a thrashing-mill, this could easily be effected. This is an admirable practice, for in this way, the band may be made of any required dimensions;—the waste of much corn is prevented, more especially when the crop is ripe,—less time is wasted in reaping,—and there is no risk of the bands growing in wet weather. Even children are thus early taught a degree of subordination and order, and rendered useful in carrying on the business of the farm, without being subjected to labour above their strength to perform ([190]).

Sect. XIX.—*Of Harvesting.*

Corn, when cut down, is usually put into sheaves and *shocks*, (provincially *stooks*), or two rows of five or six sheaves each, with two more spread open on the top, for protection against rain, called the *hooding*, or head-sheaves. In wet seasons, the crop is sometimes put into small stacks in the field, where it remains, till it be fit to be removed to the stack-yard. The expense, when the work is properly conducted, is not considerable, and the corn is put out of risk. By making the stack in the centre of the space from which the corn is to be carried, the operation goes on very quickly. In one day, in the precarious harvest of 1816, an eminent farmer in East Lothian ([191]), secured, in this way, thirty-two statute acres, in which grass-seeds had been sown, at an expense of about two shillings per acre. Nineteen men were employed, of whom twelve were put to carry the corn upon hand-barrows to the stack, three to build, three to fork, and one to dress the stacks, and to rake up the loose corn. The ground was so wet at the time, that had carts and horses been put upon it, the young grass would have been destroyed. In Cornwall, from the dread of moisture, they are accustomed to put up their corn in small stacks, *the very evening in which their crops are cut down;* and the farmers consider their crops to be perfectly safe, if once put dry into one of these wind, or *arish mows*, as they are called. Each stack contains 180 sheaves, and there are generally three to an acre. Mr Curwen was accustomed to stack his corn in the field, regard being had to future convenience in its removal afterwards ([192]).

When corn is sufficiently dry, it is carried ([193]), either into a barn, or stacked in a yard adjoining to the farm-offices. The latter plan is preferable on various accounts. 1. The grain and straw, if put into a barn, must be much drier than is necessary for the largest ricks, and consequently, must be longer exposed to the vicissitudes of the weather. 2. In barns, the grain is peculiarly liable to the depredations of vermin. 3. Corn in the straw, keeps much better in the open air, than in close barns. 4. The expense of constructing, and keeping these buildings in repair, is very considerable. Few operations at the same time, require to be more scrupulously attended to, than the erecting of corn-stacks, which should not only be substantially done, so as to secure the crop effectually, but neatly executed ([194]).

The old practice, of stacking corn on the ground, in the yard, even though bottomed with loose dry straw, was not a little exceptionable; part of the grain being apt to imbibe moisture, and the whole liable to the depredations of vermin. It was much improved upon by Mr Coke, who laid clay at the bottom, six or more inches thick, and prevented vermin from entering the stacks by placing a coat of mortar round the bottom of each. But now, it is found, that corn may be preserved in the open air, either in corn-stands built of stone or brick ([195]), or upon pillars made of stone or cast-iron, without receiving the slightest damage. Where cast-iron is accessible, that material is to be preferred, as no vermin can get up so slippery a surface. Seven, or nine pillars of cast-iron, are sufficient for a common-sized round stack, the expense of which, will not exceed from forty to sixty shillings, according to the price of iron ([196]). The frame of coarse wood, on which the corn is laid, usually costs from eight or ten, to thirty or forty shillings more. The whole amount is often repaid by the saving of the first year. Unfortunately however, the greatest precautions are often taken in vain. Inconsiderate persons will set ladders and other articles against the stacks, and render useless all the precautionary measures that have been adopted.

There is a practice in Scotland, of using what is called *bosses*, which, when joined to cast-iron pillars, has brought the stacking of corn to great perfection. They are thus formed: A triangle is first erected in the middle of the frame, which forms a boss or hollow, about three feet wide: a few spars of fir are nailed across the boss, so close, as to preserve the sheaves from falling into it; but when these cannot be got, a straw rope is commonly used in their stead. After the builder has reached the top of the boss, he places on it a sack filled with straw, which, when he builds round it, he pulls up, until he reaches the top of the stack. By this means, crops of wheat, barley, or oats, can be harvested with less exposure to the weather, and in better condition. It may be proper to add, that, in very bad harvests, by means of the invention of bosses, one row of sheaves of corn, may be put on the stacks, "*from the sickle,*" (placing the heads of the sheaves to the centre), and may thus be effectually secured, a great object in a wet climate ([197]). When these sheaves are thoroughly dry, others may be added.

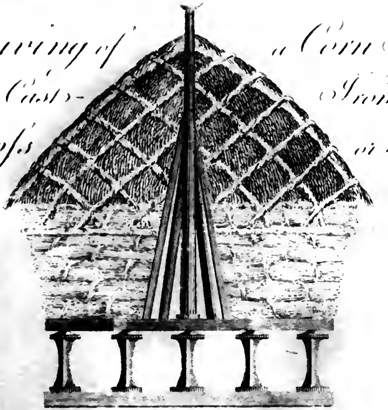
Engravings are annexed, for the purpose of giving a better idea, than any description could furnish, of these useful inventions. (See Plate III).

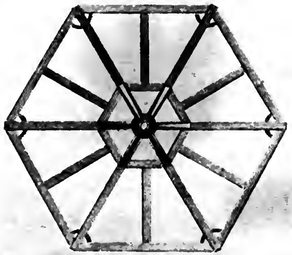
The harvesting of beans, being often attended with peculiar difficulties, the improvements which have been made in that operation, deserve to be more fully described. After they are cut down, and put in small sheaves, not exceeding from six to eight inches in diameter, they ought to be immediately conveyed, if intended to be followed by a crop of wheat, to dry in another field, otherwise the season of sowing may be lost. The additional trouble and expense of their removal, is amply compensated, by the difference in value, between a crop of wheat, and that of any other grain. Beans, on this plan, if put in an airy situation, will be sufficiently dry to be stacked on cast-iron pillars, *with bosses*, in ten, twelve, or fourteen days, according to the state of the weather, after they were cut, but always in less time than they would be fit for stacking, if left on the soil where they were raised. By the operations above detailed, namely, the cutting off the tops of beans;—reaping them early;—conveying them to another field to dry;—and stacking them on cast-iron pillars, with bosses, the harvesting of beans may be considerably accelerated, while more time is given to prepare the soil, for the succeeding crop of wheat;—advantages of no common magnitude.

Corn stacks are, in some districts, built in an oblong, instead of a round form; but though these oblong construc-

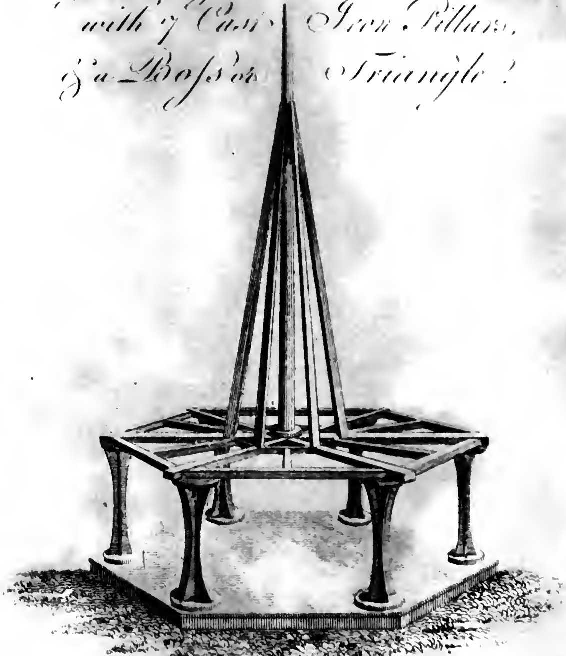
Plate 3.

Engraving of a Corn Stack, with 7 Cast-Iron Pillars, & a Boss or Triangle.





Engraving of a Corn Stand, with 7 Cast Iron Pillars, & a Boss or Triangle.



Neele sc.

tions, require less time and labour, and fewer covering materials than the others, yet they are objected to, as interrupting the free circulation of the air in the corn-yards,—being more liable to injury in damp weather,—and, unless carefully placed, more apt to be overturned by wind, than those of a round construction.

Before concluding this subject, it is proper strongly to inculcate the necessity of unceasing activity, at that critical period when the labours of harvest are going on. Some husbandmen have rarely, if ever, any spoiled grain in their possession; while others, of more tardy habits, are seldom without it. A disposition to trifle or procrastinate, and to rely on the continuance of good weather, is quite unbecoming the character of an industrious and intelligent husbandman; and there cannot be a better criterion, by which to judge of the agricultural skill and spirit of any particular district, or the management of those who cultivate it, than to ascertain, how the business of the harvest is conducted ([198]).

Sect. XX.—*Of Thrashing Grain.*

The operation of separating corn from the straw, has been recently brought to a degree of perfection in this country, that some years ago, would have been considered as unattainable. The advantages of the new mode, in a general point of view, have been already explained, (Chap. II.); and it would have been desirable, in this place, to have given a statement, of the pecuniary profit derived from it; but such is the diversity of opinion respecting the expense of keeping horses, and such the difference of wages in the several counties, that it was found impossible to make a calculation that would be generally acceptable, or that would be applicable to more than one or two districts. The average profit from the mill, worked by horses, when compared to the flail, it would appear, is from 3s. to 4s. per quarter for wheat, from 2s. to 3s. for barley, and from 1s. to 2s. for oats; but where oxen are used, instead of horses, or where the machine is driven by water, or wind, the expense of thrashing by the mill, is considerably reduced, and the advantage comparatively augmented.

If the old plan of thrashing by the flail, had continued in use ([199]), the task was so severe and irksome, while, in time of war, labourers fit to perform it were so scarce, that the expense must have greatly reduced the profit of the farmer, and the value of land (200). But the waste of grain from that imperfect mode of thrashing, and the pilfering which often attended it, was yet more vexatious; and the labourers could not always be prevailed upon, to thrash the corn wholly out of the straw, *even when they knew that their own families were in danger of suffering from the want of bread* (201). Nor is that to be wondered at. Few men are dexterous at handling a flail; and labourers in general, would rather work without doors, even in wet weather, than subject themselves to the severe, dusty, and unwholesome toils of a barn (202).

In the western districts of England, they are desirous of extracting the grain, with as little injury as possible to the straw. For that purpose, the ears are cut off, and thrashed separately from the straw (203), which is converted into a species of reed for thatching, or used for litter (204).

Sect. XXI.—*Of Dressing, or Winnowing Grain.*

The old imperfect modes of dressing grain, either by the action of wind operating between two doors of a barn, or by conveying the corn to the summit of some adjoining eminence, where it was winnowed by a natural breeze, are now laid aside. The idea of a winnowing machine, for the purpose of raising wind artificially, is supposed to have originated in China, and was there applied to the dressing of rice. It was thence brought into Holland, and attached to mills for making pot or pearl barley. Its introduction into Scotland, above a century ago, is attributed to the patriotism of Andrew Fletcher of Salton, and the ingenuity of James Meikle, whose son was the inventor of the thrashing-mill. But its construction on a larger scale, so as to render it applicable to all sorts of grain, is said to be owing to a person named Rogers, a farmer near Hawick, in Roxburghshire, who, about the year 1733, commenced a manufacture of them, which he and his descendants carried on to a considerable extent (205). It is impossible to calculate, to what inconveniences and losses the farmers must have been subjected, before their difficulties were removed by this most useful invention (206).

The thrashing-mills erected, have, almost in every case, a set of fanners attached to them; and those on the largest scale, are sometimes provided with a second pair, by which the cleaning of the grain, is rendered so complete, as to require little or no dressing afterwards. From the inequality of motion, however, necessarily attendant on so violent an operation as that of thrashing, and the additional strength required, which is severe on horses, when they are employed, the second pair of fanners is now generally laid aside; the judicious husbandman, who wishes to secure at market, a character for well-dressed grain, finding it more for his interest, to give the final dressing to his grain, in a deliberate manner, by hand-fanners ([207]).

By these machines, with the aid of riddles attached to them, all dirt, seeds of weeds, chaff, and other refuse, are separated or blown away, and the grain parted into divisions according to its quality, by which it is rendered intrinsically more valuable than if the good and the inferior were mixed together; in the same manner as a fleece of wool, fetches a much higher price, when broken or sorted by the wool-stapler.

The thorough dressing of grain, and making the whole stock correspond with the sample produced at market, are important objects for a farmer to attend to. In this way, all disputes with purchasers are avoided, and the grain fetches its full value. One or two per cent. of bad grain left in the stock, will often lessen the price from five to ten per cent. when the market happens to be dull; whereas the imperfect grain, if dressed out, and given to the farmer's horses, or, if not sold separately, otherwise used at home, would be got rid of to more advantage.

Sect. XXII.—*Improving the Quality of Grain and Flour.*

When wheat has been injured during a bad harvest, it ought to be put into small stacks, in which state it will dry much more quickly, and be sooner rendered fit for grinding into flour. If large stacks are used, *bosses*, or triangular frames, ought to be employed. If stacked in a damp condition, it should rarely be thrashed earlier than the summer after it had been harvested, when its condition will be greatly improved.

Wheat, if not in good condition, derives much benefit from kiln drying; but it should not be ground, (unless in cases of necessity), until some time after it has undergone that operation. It ought to be moderately kiln-dried, with a slow heat, and frequently turned. But if the grain be musty, it ought to pass through a previous process, which is thus described by an eminent chemist.

The wheat must be put into any convenient vessel, capable of containing at least three times the quantity, and the vessel must be subsequently filled with boiling water; the grain should then be occasionally stirred, and the hollow and decayed grains, (which will float), may be removed; when the water has become cold, or, in general, when about half an hour has elapsed, it is to be drawn off. It will be proper then to rinse the corn with cold water, in order to remove any portion of the water which had taken up the must; after which, the corn being completely drained, it is, without loss of time, to be thinly spread on the floor of a kiln, and thoroughly dried, care being taken to stir, and to turn it frequently, during this part of the process ([208]).

By this operation, corn, however musty, may be completely purified, with very little expense, and without requiring previous chemical knowledge, or any expensive apparatus. Mere ventilation, however, has been recommended, as a means of preparing grain for use, sufficiently effectual.

When grain is infected by smut, it can be thoroughly cleaned, however black it may be, in the course of three washings, in a wooden tub, resembling a mill for washing potatoes ([209]). The wheat must afterwards be kiln-dried.

It is generally supposed, that if wheat be much injured during a bad harvest, the flour made from it, will not ferment, or bake into loaf-bread, and that it is only fit for distillation, or to be eaten by live stock. But with the aid of soda, the flour may be much improved; and, at any rate, may be made into cakes ([210]), or biscuit, and consumed with safety and advantage. In France, they recommend, in such cases, that the water used in making the bread, should not be so hot as usual;—that the dough should be made firmer, and with a greater quantity of salt;—that the bread should be made into smaller loaves;—that the oven should be more heated;—and the loaves kept longer in it. The more the bread is baked, there is the less danger in using it, and it should, if possible, not be consumed, till two or three days after it has been baked ([211]).

Sect. XXIII.—*On preserving Corn and Flour.*

In several countries, such as Switzerland, Poland, &c. great labour and expense are bestowed, in storing and preserving corn for times of scarcity. In some places, deep pits are made in the solid rock, and in others, caves are dug in the sides of hills, in which the grain is deposited. Large granaries have been also built of stone, so as to admit of a free ventilation, and a frequent stirring of the corn. But, for any moderate period, (say one or two years), there is no mode so advantageous, as the keeping grain in the straw, in a large and well-built stack, properly secured from vermin.

As the straw, however, becomes less valuable the longer it is kept, and as stacks are exposed to the risk of fire, whether malicious or accidental, the discovery of a cheap and effectual mode of constructing a granary, has long been wished for.

Farmers, indeed, seldom incline to have much of their thrashed corn on hand at once; but there ought to be, on every farm, places of security, capable of containing a portion of the grain annually produced upon it, in case there should be a deficiency of market. Such granaries, scattered over the whole country, would be the best security against famine that has hitherto been thought of, and being less visible, would not be so obnoxious, nor liable to the same hazards, from popular frenzy, as large stacks, or even well filled barns (212).

If there should be any objection to granaries, there is no difficulty in preserving flour, in a manner that would answer the same object. When Bonaparte took possession of Leipsic, prior to the battle which proved so fatal to the French army, he found a number of barrels of flour, that had been kept there for several years, and was in perfect good condition; a sufficient proof that flour, when properly manufactured, and closely packed in good condition, is not an article so liable to injury, or so difficult to preserve, as is commonly imagined. In vessels made of block-tin, and sufficiently hard pressed, it may likewise be kept sound, for a great length of time, and during the longest voyages. The same plan would likewise answer if the cases were made of iron.

Sect. XXIV.—*Of Straw.*

The subject of straw, is of greater importance than is commonly imagined; and the value of that article, taken in the aggregate, entitles it to more attention than has hitherto been bestowed upon it. Farmers are apt to consider it as of little or no worth, because it is not usually saleable, and is rarely estimated, separately from the yearly produce of the soil. But though seldom sold, (except in the vicinity of towns), it has an intrinsic value, as a fund for manure,—a means of feeding stock,—and other useful purposes.

1. *On the Weight of Straw produced by the different Crops.*

It is evident, that the quantity of straw produced per acre, must differ, according to a variety of circumstances; as, 1. The species of grain cultivated; 2. The different kinds of the same grain, for red oats produce less straw than other sorts ([213]); 3. The season, for in a dry season the quantity is less than in a moist; 4. The soil, for in fertile soils, the straw is more abundant than in poor ones; 5. The season when the seed is sown, for spring-sown wheat has less straw than that which is sown in winter; and, 6. The manner in which the straw is cut, for an inch at the root-end of the straw, is heavier, than two at the top ([214]).

It is desirable, notwithstanding these diversities, to be enabled to form *some general idea*, of the average produce *in straw*, of each kind of grain; and the average weight of the whole: but owing to the little attention hitherto paid to the subject, and the scantiness of authorities, the weight cannot be ascertained, with the accuracy that could be wished. It is probable, however, that the following estimates are not far from the truth.

Mr Young stated, that the average produce *in straw*, stubble included, of all the different crops, rejecting those upon the weaker soils, might be calculated at 1 ton 7 cwt. per English acre.

Mr Middleton calculates the produce of the different crops in straw, per acre, as follows:

	Cwt.	*lbs.*
Wheat,	31 or	3472
Beans and Pease,	25 —	2810
Oats,	25 —	2800
Barley,	20 —	2240
Average nearly,	25 or	2828

or about $1\frac{1}{4}$ ton.

Mr Brown of Markle, has drawn up the following estimate, of the produce of straw, from the different crops usually cultivated in Scotland. The weight calculated in Scotch stones of 22 lbs. avoirdupois each.

	Stones.		*lbs.*
Wheat,	160	or	3520
Beans and Pease,	130	—	2860
Oats,	130	—	2860
Barley, [215],	100	—	2200
Total,	520	or	11,440
Average,	130	or	2860

Crops of rye furnish much straw, having, in some cases, yielded two tons per statute acre. But on the whole, about 1 ton 5 cwt. may be stated as the average of the kingdom ([216]).

2. *Of the Value of the different kinds of Straw, and its total Amount.*

The intrinsic value of straw must vary materially, according to its feeding properties;—the quantity of manure into which it may be converted when used as litter;—its fitness to be employed as thatch;—or its use in manufactures ([217]);—these being the chief purposes to which it is applicable; but, in general, the price principally depends on its vicinity to large towns, where straw is wanted for litter, which can be repurchased, when converted into dung, and where other manures can also be obtained in its stead.

At Bath, during the winters of 1791 and 1792, wheat straw was so dear, that innkeepers, from a principle of economy, used their worst hay, instead of straw, as litter. At Oxford, in 1806, straw sold at from L.2, 2s. to L.4 per load ([218]). But this article is commonly dearer in London and its neighbourhood, than in any other part of the kingdom. It is there sold by the load, which consists of 36 trusses, of 36 lbs. each, or 11 cwt. 2 qrs. and 8 lbs. in all. The price was formerly from 25s. to 40s. per load; it afterwards rose to L.3, 12s. ([219]), but in February 1817, had again fallen to L.2. Even at that price, it produces above L.4 per statute acre.

In the vicinity of Edinburgh, wheat straw has sold for 9d. per stone (22 lbs. avoirdupois to the stone), for litter; and calculating the quantity at 160 stone per English acre, the amount is L.6. Oat straw sells nearly at the same price, being reckoned more palatable and nutritious both for cows and horses; and the crops are often so weighty, that it fetches L.7 per English acre. In Aberdeenshire, on the other hand, straw is seldom worth more than L.2 per acre ([220]).

The value of straw for feeding stock, depends much upon the season when it is consumed. From the beginning of November, to the 1st of March, when black cattle have turnips in abundance, the straw of oats, and likewise of beans and pease, if well harvested, may be safely used *as a substitute for hay*, and may, during that period of the year, be reckoned at from one half to nearly two-thirds of its value, whatever the price of hay may be. Ninepence per stone, however, when hay is 1s. 6d. per stone, may be considered its fair value for feeding, during spring; and 6d. as the average during the whole year.

In regard to straw used entirely as litter, it is calculated by Mr Brown of Markle, that 130 stones of straw, the average produce of an acre, will yield four two-horse cart-loads of dung, worth, in East Lothian, 10s. per load; that is, at the rate of 3d. per stone for the straw, and L.1, 12s. per English acre. Straw for thatching will be nearly of the same value. On the supposition, therefore, that there are eight millions of acres of cultivated land, annually sown in Great Britain, producing, on an average, 130 stone of straw, one-fourth of which is consumed by feeding, and in that case worth 6d. per stone, and three-fourths as litter or thatching, worth only 3d., the total value of the straw in the kingdom, may be estimated as follows:

Two millions of acres of straw, at 130 stones per acre, worth 6d. per stone, employed in feeding stock, - -	£.6,500,000
Six millions of acres, at 130 stones per acre, worth 3d. per stone, for litter or thatching, L.1 : 12 : 6 per acre,	9,750,000
Hence eight millions of acres, produce in straw upwards of L.2 each: in all, - - - - - -	£16,250,000

The straw, therefore, annually produced, is of much more consequence than is commonly considered; more especially when its great importance, as a means of renewing the fertility of the soil, is duly estimated ([221]).

3. *Of the various Purposes to which Straw is applicable.*

These may be considered under the following general heads: 1. Feeding stock;—2. Litter;—3. Thatching;—and, 4. Miscellaneous purposes.

1. *Feeding Stock*.—In former times, this was the great object to which straw was applied; almost every stalk, ex-

cept what was employed in thatching, was devoted to that purpose, and scarcely any left to litter the stalls. The husbandry of the celebrated Bakewell was then much commended, who used no straw for litter: but if he had more than his own cattle could consume, would rather take in those of his neighbours, and give straw and attendance for nothing, than use it for litter. No species of dung was then valued, that had not passed through the body of an animal; and though, by littering, more muck was made, yet the dung produced from straw, when eaten, was considered most profitable. Bakewell, however, became convinced by experience, that he had adopted an erroneous system, and latterly littered his stock amply. His stock were thus also kept in a superior condition, and his supply of manure was abundant.

But though the plan of feeding stock solely upon straw, cannot be approved of, yet neither is the opposite extreme, that of expending the whole straw, even that of pulse, *in litter*, deserving of approbation. A moderate quantity of straw given to cattle, with turnips, or other succulent food, contributes much to their health. The straw of pulse, when properly harvested, with an adequate proportion of corn, may be given with advantage to working horses, and may save more expensive articles. Without some article of inferior quality, rich food, in too great quantities, would become loathsome and injurious. Dry food is advantageous, by its absorbing the fluids in the stomach, by which that organ has greater power to act upon them; and though such food may not be so necessary, for the sake of the nourishment it affords, an animal may thus be enabled, to take greater quantities of more nutritive aliment. Unless the stomach and bowels be properly distended, digestion is but imperfectly accomplished, and the richest food will not nourish an animal with equal success.

The price of hay indeed, has become so enormous, that it enforces, to a certain degree, the consumption of straw; nor can the soiling system, so advantageous to the farmer, be carried to the same extent, unless cattle and horses are partly fed with straw and haum during the winter season. Indeed, in the early stages of fattening cattle, straw is as good as hay, for using along with turnips. A greater quantity of clover might, under this system, be employed in summer soiling, which otherwise must have been made into hay, and consumed in winter, instead of straw. But it is absurd to suppose, that the straw should be wholly consumed by cattle, for such food alone, would not fatten them, and their dung would be of little value.

The properties of the different kinds of straw, for feeding stock, shall next be considered.

Wheat Straw.—In some parts of England, it is used as fodder for stock, and frequently cut into chaff, to be eaten by horses with their corn. But in Scotland, wheat straw is scarcely ever used as fodder for domestic animals, except in cases of necessity, when other food cannot be procured. It is there considered, that wheat is seldom cut down till it is thoroughly ripe, and then its straw dries and declines in value, as food for cattle, in proportion as the seed attains perfection. Straw indeed, is much richer, when the plant is in flower, than when it has come to maturity; and the nearer the seed arrives at the stage of ripening, the drier, more withered, and less nutritious does the straw become. Every farmer and feeder of horses knows well, that rye-grass hay, cut before the seed is nearly ripe, is much more valuable, and gives a higher price, than when the seed has ripened before cutting. The case is the same with every other species of that sort of food. Wheat straw must therefore become less nutritious, if it is not cut, till the seeds have become completely ripe, than if it had been reaped sooner. If it is used as fodder, it should be cut into chaff, and enriched, by being boiled or steamed with potatoes, turnips, or some other article, by means of which it might be rendered softer, more palatable, and more nutritious.

Oat Straw.—This straw should be given uncut. It was formerly excellent feeding for stock, when raised on land full of couch, and other natural grasses; but since the introduction of fallow, and horse-hoed crops, very little grass, comparatively, is now found in the straw of any kind of corn. In some counties in England, *oats are given in the straw*, or corn and all, as a species of fodder, which is technically called "*cut meat.*" But that plan is condemned as slovenly and wasteful; for the proportion between straw and corn being so different, it is impossible for a farmer to do justice to his cattle or horses, by a process attended with so much uncertainty. When given in this state, there is a great risk of having the corn unmasticated and totally wasted.

Barley Straw.—When this straw is grown in a southern climate, it is much relished by stock, not being tough, consequently easily eaten, and so sweet, that cattle are particularly fond of it. In Scotland, however, it is considered to be much inferior to oat straw, for its feeding properties; and it is extremely difficult to save it in any tolerable order, more especially with clover. Its quality also, is much injured, when, instead of being put in sheaves, it is spread on the ground, (the practice in many English counties), for the air and dew, tend to injure every species of fodder ([222]).

Bean Straw.—If well harvested, this straw forms a very hearty and nutritious kind of food, for working horses and cattle, in the winter season; but does not answer so well *with carriage or saddle horses*, being apt to hurt their wind. As bean straw alone is rather dry, a mixture of pease straw, particularly of white pease, which is sweet and nourishing, improves the fodder ([223]).

Pease Straw.—The haum of white pease, if cut green, and dried quickly, in the full vigour of its sap, is fodder of a superior quality, and horses will thrive on it nearly as well as on hay. For sheep, this food is so excellent, that on some farms, where they make a part of the stock, pease are sown wholly on their account ([224]). The straw of early white pease, applied to sheep, Mr Young observed, was the most valuable return made by straw. Pease haum, sometimes produces a ton and a half per acre, and if well harvested, will sell, according to the price of hay, at from L.4 to L.7, 10s. per acre, being often of almost equal value to the grain itself.

Tare Haum, or Hay.—Tares have sometimes produced from ten to twelve tons of green food, which, when dried into hay, were found to be one-fourth part of the weight of the fresh-mown tares, or from two and a half to three tons per acre; that is, when they are not suffered to stand for seed, but the whole crop is mown, partly for soiling, and partly for hay, which is of the highest quality. When suffered to stand for seed, the weight of the hay is still less ([225]). For the purpose of making the best hay, the crop should be mown, as soon as the blossoms begin to fall off, or the pods to form. They require a continuance of dry weather, to be cured in perfection; but if well harvested, they are worth from L.8 to L.12 or even L.15 per statute acre ([226]).

The rules respecting the consumption of straw in feeding, may be considered as applicable to, 1. Cattle; 2. Horses; 3. Sheep; and, 4. To some particulars of a general nature.

1. *Cattle.*—Straw, of good quality, may, at the commencement of the fattening process, be given to cattle, as an economical mode of feeding them, accompanied by turnips; but in the more advanced stages of that process, hay is so much superior, that it should, if possible, be supplied. If

straw be given for only a month or six weeks in winter, it will be a great saving in so expensive an article as hay. In spring, hay, from its being closely packed, and less exposed to the influence of the atmosphere, retains its nutritive juices much better than straw; hence the former has greatly the advantage over the latter, and is therefore to be preferred. When cattle are fed with distillery offals, straw should be given them twice a-day, with the grains or wash; for it has been found, that without straw or hay, cattle would not feed so well, owing to their not being able to chew the cud ([227]).

2. *Horses.*—It is disputed, whether working horses should be fed in winter with straw or hay, though all parties admit, that during the severe labour of the spring months, hay is essential. But pease and bean straw certainly make good fodder for horses early in the season, if not injured by rain. With that food, and two feeds of corn, horses will not only plough three quarters of an English acre per day, but are usually full of health and vigour, when the sowing season commences. In regard to horses that are not worked, it is a good practice, to throw the straw before them in the stall, before it is spread under them, particularly if it be sweet and fresh. They always find something to pick out of it, and it makes a wholesome variety in their diet.

3. *Sheep*, &c.—There is no food of which sheep are fonder than pease straw ([228]); and where circumstances are favourable to that crop, pease might be cultivated merely for the sake of the straw, from the advantages that would thence be derived by the sheep farmer. Indeed, when it is proved by experience, that this crop can be obtained from lands preparatory to sowing wheat, without any expense or injury to the soil, no opportunity should be lost, by which such valuable fodder could be obtained ([229]). Tare straw would answer the same purpose. In Flanders, the straw of beans is reckoned excellent for sheep, and is said to produce superior mutton.

4. *General Rules.*—The value of straw for feeding, depends upon the soil and climate. In regard to soil, straw from fertile land, must be much more nutritive, than from land of inferior quality. As to climate, it is asserted, that the straw of wheat, barley and oats, contains more saccharine matter in the southern, than in the northern provinces of France, and that the superior sweetness of the one over the other, may be ascertained by masticating it ([230]). In good seasons, therefore, it must be more nutritious in this country, than when they are unfavourable.

Straw keeps much better unthrashed, in a large stack with its corn, than in a barn; but straw, in whatever way it is kept, more especially white straw, loses part of its value as fodder, after the sharp dry breezes of the spring months have set in. It is seldom given to working horses, after the month of March.

Straw given to stock, should be constantly made use of as soon after it is thrashed as possible; for if exposed to the influence of the atmosphere, it becomes either musty or too dry; and in that state, cattle neither relish, nor thrive on it so well. If it must be kept a length of time for fodder, it should be bound *in trusses*, in which state it is easier moved, lies in less room, and retains its strength and flavour, rather longer, than when loose; or it may be secured, in a stack properly built, trodden down, and covered.

There is certainly much nourishment in the heads of grain in general, and particularly in the awns of barley; but these require, either to be steeped in cold water, or to have boiling water poured upon them, before they are given to stock. Cow-keepers will give even a higher price for the awns of barley, than for the heads of wheat.

It is an useful practice to mix a portion of straw, particularly the straw of oats, with the aftermath of grass, or second crop of clover, at the time of stacking it. The straw absorbs the grasses and moisture as they exhale from the hay, by which the straw acquires juices and a flavour which are agreeable to cattle; the hay which, in other circumstances, would be spoiled, is in this manner cured, and the mixture is excellent food for stock; while the harvesting of the grass, or clover crop, is thereby accelerated ([231]).

Some farmers give the best straw to the young stock, and the inferior sort to oxen. Others, however, reverse the practice, on the idea, that the older the cattle, the better food they require. Indeed the best straw, without the addition of turnips, or other sorts of roots or cabbages, is but miserable food for oxen. The prudent method is, to give the inferior straw, in the beginning of winter, while there is plenty of other nourishing articles to be eaten with it.

In the consumption of straw as fodder, the inferior sorts should be first made use of, and afterwards those of a better kind. It is necessary that stock, when fed on so coarse an article as straw, should have an abundant supply of water at their command ([232]).

It is disputed, where straw is the chief food for cattle, whether it should be given sparingly, or in abundance. By the advocates for the sparing system, it is maintained, that cattle may be satiated with straw if served with it in too great plenty, that their breathing on it injures its quality, and that they do better, when straw is regularly dealt out to them, which is more the case in years of scarcity, than in plentiful seasons, when it is thrown before them in profusion. On the other hand, it is contended, that straw is not rich enough to produce satiety, though, when cattle are tied up, it may be a good plan to give them but little at a time, as any change must be acceptable to them. But cattle in a straw yard, require fodder in profusion, that they may pick out the best, and leave what they do not relish for litter. More straw should be given, when the weather is wet, and less when it is dry; and care should be taken to proportion the quantity of straw given, to the number of cattle in the yard, in order that the dung may be properly prepared.

The straw of some varieties of wheat, has a pith resembling rushes. It has not yet been ascertained, whether the straw of those kinds of wheat, be in any respect more valuable, than that of the common sorts; but there seems little doubt, that the straw of autumnal-sown wheat, is more harsh, and less agreeable to cattle, than the straw of wheat sown in the spring ([233]).

It is remarked, that the straw of corn is weaker, in countries where the vegetation is rapid, as in Scotland, than in the southern counties of England, where the growth is slower and more regular; and that the straw of barley, sown in the month of March, or beginning of April, grows shorter between the joints, and is much stiffer than the straw of the same crop, sown in the latter end of April, or the beginning of May, which latter crops, in wet seasons, generally fall down, while the former stand. This is a circumstance which is favourable to the practice of early sowing, in northern climates.

The ancients were accustomed to prepare their straw for feeding stock, by keeping it for a considerable time sprinkled with brine. It was then dried, rolled up in bundles, and given to oxen instead of hay ([234]). The addition of brine or salt, was certainly an excellent plan, and by a similar practice, the straw consumed in this country, might be greatly improved. Now that the tax on salt is removed, this plan ought to be generally adopted.

2. *Litter.*—The use of straw for littering or bedding stock, answers two purposes: 1. It keeps the animals warm and dry, and enables them to repose in comfort; and, 2. By the

same means, straw is mixed with the dung and urine of cattle, horses, &c. and converted into a rich manure.

All the various sorts of straw answer the purposes of litter. Some farmers prefer the straw of rye, others that of wheat, which absorbs a great quantity of urine and moisture. The straw of pease and beans, when well broken by thrashing, makes soft bedding; but if well harvested, should be applied to feeding stock. Cattle when soiled on clover, and other articles, or fed on turnips, are kept in a state of greater comfort when they have a sufficiency of litter.

In the London markets straw for litter is drawn straight in handsome trusses; and if thrashed in mills, is less saleable, on account of its being more bruised, less sightly in the truss, and less durable in use, an object of some importance, where straw is so dear; at the same time, it is probable, that the advantage of a softer bed for the horses, would more than compensate for the additional expense ([235]). It is singular, that the ancients were accustomed to break straw upon stones, for the purpose of rendering it more easily mixed with dung, sooner dissolved, and better adapted for litter([236]); an operation which is now so effectually done by means of the thrashing-mill.

By some, littering stock with straw, has been considered to be unnecessary; others contend, that all the straw of a farm ought to be exclusively appropriated to that purpose, and none of it applied to feeding stock: the truth seems to lie between these extremes.

In Arabia, where the finest horses in the world are kept, no straw is used as litter. In Sweden, and in Russia, instances are quoted, of horses lying on boards, and of cattle standing and lying on a framing of wood work, without any straw, or substitute for it, as bedding ([237]). Such plans, however, will not answer for horses, if exposed to severe labour, as, in that case, they require rest, in the most advantageous manner in which it can be given them.

It may likewise be observed, that the principal advantage of littering, with a view to manure, arises from the straw absorbing the urine, for which purpose it is certainly well calculated. But wherever straw is scarce or dear, peat earth, or fine mould, might be advantageously employed for the mere absorption of urine. Other substitutes also might be used for litter, as fern, shellings of oats ([238]), or small shell sand, all of which have been found to answer.

Straw, however, is the fittest article for this purpose, for, by fermentation, it is reduced into a gaseous state, and by moisture into a fluid state, and, in either case, its whole substance is applicable as food for plants. The more of that article, therefore, that can be converted into manure, consistently with the other objects which require the farmer's attention, so much the more will his interest be promoted.

Mr Young was of opinion, that it was impossible to raise sufficient quantities of manure, more especially where soiling was practised, if any straw were eaten; and a number of the best farmers in Norfolk maintain, that all straw should be used as litter, and trodden into dung, by animals feeding *on much better food*, as turnips, hay, or oil-cake. The principle can never be generally carried into effect, for all farms, as now cultivated, do not produce turnips, which is the best article to use for rotting straw, from the immense quantity of urine it produces. In regard to hay, or oil-cake, these articles are too expensive, and often too scarce, to make the use of them general; and besides, such *dry food* furnishes little moisture to the dunghill, without which it cannot be so effectually converted into manure.

It appears from the statements of several eminent farmers, that one ton of straw, if properly manufactured, that is, augmented in weight, by the dung and urine of the stock maintained upon the farm, will produce from two, to even four tons of manure ([239]); and as an English acre of grain, yields more than a ton of straw, hence, on a farm where 300 acres are sown yearly, nearly 100 of them may be manured from its own produce, at the rate of 12 tons per English acre, without the aid of extraneous substances, provided the four-course rotation of, 1. Turnips; 2. Wheat, or Barley; 3. Clover; and, 4. Wheat, or Oats, be adopted. Where the clover is pastured the second year, (which is an excellent system), even less manure will be required than the quantity above mentioned, while the produce of straw, will annually become more abundant, during the remainder of the course.

As 12 tons of dung per English acre, are necessary in general cases, which would require all the straw produced on the farm, according to its average produce, means ought to be devised, without the aid of any extraneous manures, to make up the deficiency, where a part of the straw is applied to the feeding of stock. The greatest care ought, therefore, to be taken, that the crop be cut as low as possible; while by the aid of mould or peat earth, much urine may be absorbed, that would otherwise be lost. The making of composts, likewise, ought not to be neglected; and where this system is practised, stock are maintained with economy, and the soil kept in a fertile state, in a great degree, from its own resources.

3. *Thatching.*—For many ages straw was the common material for roofing farm-buildings and cottages, and was formerly made use of even in towns; but the risk of fire, (to which whole villages have fallen a sacrifice from a single spark);—the loss sustained by vermin, which shelter themselves in the straw;—the expense of additional rates of insurance on thatched buildings, from 1s. to even 3s. per cent. in cases where they were considered to be doubly hazardous;—the increased difficulties of making a roof with straw thrashed by mills, and consequently in a broken state ([240]);—the practice of covering buildings with slate or tiles;—and the greater demand for manure, in consequence of the improved state of agriculture, have all contributed to diminish the quantity of straw used in thatching. This is a fortunate circumstance for agriculture, as little straw can be spared from litter, even for feeding stock, and still less for the covering of houses. On this subject, Mr Young very justly observed, that thatched roofs lessened the quantity of dung on a farm, to such an extent, that they ought to be universally prohibited. Fen reeds, and in mountainous districts, heath, may be used, when slates or tiles cannot be had on reasonable terms.

In the more northern districts of Scotland, straw is mixed with clay, and thus a plastered roof is made, which consumes but little straw, and is not liable to take fire. But it is heavy, and requires stronger supports, on which more durable materials might be placed. Walls of clay, mixed with straw, are not unusual in several districts of England and Scotland, for gardens, cottages, and even farm-houses.

4. *Miscellaneous uses of Straw.*—There are few articles, which are applied to a greater variety of purposes than straw. Besides the uses above mentioned, it is employed for covering hay and corn stacks;—twisted into ropes, for draining;—mixed with sea-weed in a compost;—burnt for the purpose of obtaining potash;—manufactured into paper;—used in bottoming of chairs,—stuffing collars for working-horses,—and beds for the lower orders;—packing glass, china, and earthenware;—and the straw of grain, and of wheat in particular, in the manufacture of hats, bonnets, trinkets, and various ornaments, by which numbers, who might otherwise find it difficult to subsist, are furnished with the means of employment.

Sect. XXV.—*Of Stubbles.*

It is not unusual, in some parts of England, when the grain is reaped by the sickle, to cut it knee high. This probably originated from a wish to save barn-room; and to get the corn more expeditiously carted and stacked, and more easily thrashed. But the plan of high cutting deserves reprobation. By it much grain is lost, for a stubble of 12 or 18 inches, and still more, of two feet, can never be a clean one. By this plan, also, the expense both of the sickle and of the scythe is incurred. Many consider the part nearest the root, to be the most nourishing of the straw, but, at any rate, the culling and picking the best part, may be safely left to the instinct of the cattle to whom it is presented. Stubble left in the field, retards much the operation of ploughing, more especially when the plough is turned; and as it is often neglected, and left standing, until its whole substance has been materially injured, by the variable weather to which it is exposed, it may be accounted of little value to the farmer; while, under a different management, if cut with the crop, it would have proved a source of much profit.

Wherever agriculture, therefore, is practised on improved principles, crops of grain are cut so close to the ground, as to leave no stubble that can be mown, or employed to any particular use. It may be proper, however, to state, to what purposes stubble is applied, when left on the ground.

By some farmers it is mown, and collected, to litter the yards, or bottom the dunghill ([241]), but, too often, after its substance is wasted. It is sometimes burnt on the ground, (which was an ancient practice), or ploughed in, often to the injury of the succeeding crops; for the stubble rendered some lands too open, so that every fall of rain or snow filled the soil with moisture, which could not easily be got rid of. Stubbles are sometimes formed into walls, for rendering farm-yards warm and comfortable for stock ([242]). Where stubbles are properly managed, they are mown, and as carefully harvested, as any other part of the produce; being brought home, stacked up, and kept for thatching, either buildings, or the stacks of the succeeding year, or for other purposes ([243]). But by far the most advantageous mode of applying stubble, when mown and harvested, undoubtedly is, to spread it on the surface of the soil, after the land has been completely prepared for turnips, and then to burn it. This is *an infallible mode* of preventing the ravages of the fly in turnips, for they are either destroyed by the fire and smoke, or driven out of the field.

In Derbyshire, a paring plough is used, for wheat and other stubbles, by which the roots of the corn and weeds are cut; the ground is then harrowed and raked, and all the stuff thus collected, is carried home to be spread in the bottom of the fold-yard, and trodden into muck. By this operation, not only is the quantity of dung increased, but the seeds of the weeds are brought to vegetate on the stubble land thus cleared, and are easily got rid of ([244]).

In Kent, there is a practice similar to the above, that of *shimming* the stubble of beans with a plough, *having a very broad share*, as a preparation for wheat. The weeds and roots cut by this implement, are afterwards harrowed out, and either burnt on the ground, or carried to the compost dunghill. The same cleansing process, is likewise applied to wheat stubbles, as a preparation for pulse and other crops. This operation is very useful for clearing the soil from surface-weeds, especially those of a trailing or creeping growth, and for bringing the seeds of weeds, which lie upon or near the surface, into a state of vegetation, and capable of being destroyed ([245]).

Sect. XXVI.—*Of Gleaning.*

The origin of gleaning is of great antiquity. Formerly, when the practice was under proper regulations, it was attended with profit to the industrious poor, without occasioning any particular injury to the occupier. Each farmer, in ancient times, had his particular set of gleaning retainers, who assisted him in the labours of the harvest, and they were indulged with the perquisite of gleaning, after the corn had been gathered. This tended to excite, and to preserve, a mutual attachment between the two classes ([246]).

But this privilege came to be abused. Persons who had given no assistance to the farmer, nay, who resided in other parishes, presumed to glean, not only *among* the sheaves, but too often *from* them, conducting themselves in so disorderly a manner, as to occasion perpetual disputes. The mischief which this gave rise to, was often great, particularly in the common field system, where the loss incurred has been calculated as high as 30 per cent. ([247]). To avoid such depredations, the wheat crop was often cut too late, and carried home too quickly, because the farmer dared not trust it in the field, while the poor were perpetually among the sheaves. In several districts it is still the case. The courts of law have decided against any *right* to gleaning being vested in the poor; but as the practice, under due regulations, tends to promote a friendly intercourse, and kindly connexion between the upper, and the lower orders of society, it ought not totally to be given up, or extinguished.

II. *On the Rotations of Crops best adapted for different Soils and Situations.*

Notwithstanding the multitude of books on agriculture, there is scarcely an author, who, prior to the middle of the last century, seems to have formed any just ideas, either of the importance of judicious rotations, or the principles on which they ought to be regulated. All courses of crops appeared to them alike, and neither to merit praise nor censure ([248]). Happily the case is totally altered, and this most essential branch of husbandry, is now grounded on principles, as distinct and certain, as those which form the basis of any other science, or direct the practice of any other art ([249]).

It is not without much anxiety respecting the execution of the task, that so essential a branch of the present inquiry is undertaken. It is considered, as the most prominent feature in good farming;—as the most important particular that has been treated of by modern writers of husbandry, and the subject on which they have fortunately thrown the greatest light;—as capable of furnishing a considerable increase to the produce of the land;—as peculiarly constituting what may be called, *the soul* or essence of husbandry;—in short, as the true groundwork of general improvement;—and, if well understood, as the most likely means, of promoting the cause of agriculture, and the interests of the country. It cannot indeed be represented in too important a light, nor too minutely examined, its object being to ascertain, "*that mode of management, which is the most likely, for* "*a series of years, to yield the greatest quantity of useful pro-* "*duce, at the smallest comparative expense and risk, from any* "*given extent of land.*"

It is of peculiar importance, that this subject should be thoroughly investigated, as on some large estates, leases are all formed on the same model, and sometimes printed, ready to be filled up like militia schedules, or policies of insurance, prescribing, in every instance, the same rotation; whereas, in many cases, even in the same neighbourhood, a moderate variation of soil may require a material difference in cropping. Thus, on Mr Coke's estate in West Norfolk, the soil varies from light dry sand, to strong loam retentive of wet, and hence, in order that it may be cultivated to advantage, no less a number than four different rotations are necessary ([250]).

It may be proper here to give, 1. A general view of the principles, which ought to regulate the rotation of crops in every country; and, 2. A list of the crops usually raised on the different soils of Great Britain.

1. The propriety of adopting any particular system of cropping, will be considerably influenced by the following circumstances: *The Climate*, whether it be wet or dry, warm or cold; and the *situation*, whether high or low. Wet climates, and high situations, for instance, are rather favourable to the growth of oats; dry climates, and low situations, to that of barley:—*The Soil*, for sand, gravel, clay, chalk, peat, alluvial soils, and loam, have various crops calculated for each respectively; and *the subsoil*, on the quality of which, the crops to be raised must greatly depend:—*The means of improvement by extra manure*, (as lime, marl, sea-weed, town-dung, &c.), at reasonable rates; for the rotation of crops should be regulated not only by the nature of the soil alone, but conjoined with the specific manure that can be obtained at a reasonable expense:—*The state and condition of the soil;* whether it be old cultivated land, or recently improved; whether it be land that has been cropped judiciously or under an exhausting system of management; whether it be in good heart, or the reverse; whether it be foul, or clean:—and lastly,—The situation of the farm in regard *to markets*, whether they are near, or at a considerable distance; and whether they are adapted to the sale of some articles of produce more than others. For instance, a field of potatoes might be worth L.25 per acre near a town, which would not fetch from L.5 to L.10 in a remote part of the country.

2. It is of the greatest importance to determine, for what crops the soil and climate of any particular district are best calculated; and what objects may be obtained by their cultivation. In Great Britain, wheat is, with the exception of potatoes, the principal *field crop;* whereas, in Flanders, it is considered as only the fifth in point of value ([251]), and it is often raised, merely as a means of procuring manure, for the more lucrative productions of flax or hemp. That these crops should have been prohibited in former times, when husbandry was imperfectly understood, is not to be won-

dered at; but, that the same prohibition should be still continued, when the experience of Flanders proves, beyond the possibility of doubt, that flax and hemp may be cultivated once in every five or six years, without diminishing the fertility of the soil; and, when the farmer can hardly pay his rent, from the burden of rates and taxes, to which he is subjected, and consequently requires every possible encouragement, can hardly be rationally accounted for. Every crop should now be raised, *that will pay best*, at least on the estates of those landlords, who wish to have their lands occupied by thriving tenants. The employment which might be given to the poor, by the cultivation of flax, and the advantage of being rendered independent of foreign nations for naval stores, by the raising of hemp, are separate considerations.

The crops usually raised on the different soils in Great Britain, at present, are as follow.

Crops cultivated on the different Soils in Great Britain.

1. *Sand.*	2. *Gravel.*	3. *Clay.*
Turnips, Potatoes, Carrots, Mangel Wurzel, Barley, Rye, Buck-wheat, Tares, and even oats in wet climates.	Pease, Tares, Rye, Barley, (and on good gravels) Wheat, Oats.	Beans, Wheat, Oats, Tares, Cabbages ([252]).

4. *Chalk.*	5. *Peat.*	6. *Alluvial.*	7. *Loam.*
Barley, Pease, Wheat, Turnips, Rape.	Potatoes, Carrots, Tares, Turnips, Rape, Rye, Oats.	Wheat, Barley, Oats, Beans.	Turnips, Potatoes, Carrots, Mangel Wurzel, Barley, Oats, Wheat, Pease, Beans, Tares, Hemp and flax.

And on all these soils, clover and other grasses, are, in a greater or less degree, periodically cultivated.

Of the various Sorts of Rotations.

It is not unusual, in treating of this branch of the inquiry, to consider rotations, merely as they are applicable to different soils, for instance, sand, gravel, clay, loam, &c.; but the subject will be better understood, by discussing the different courses of crops, *according to the number of years they respectively require to finish the rotation;* specifying, at the same time, the soils for which they are respectively the best calculated.

In particular cases, some farmers have adopted a course of only *two years' crops*, as wheat, with crops of potatoes or beans, alternately. On the richest loams, or alluvial soils, reclaimed from the sea, or in the immediate neighbourhood of large towns, where any quantity of manure can be commanded, such a system may be practicable, but in other situations it cannot be safely adopted. A farmer who had followed this plan for the space of fourteen years near a town, during which he had four crops of potatoes, three of beans, and seven of wheat, found, though the quantity of produce had not diminished, yet that *the quality* of the wheat and beans had degenerated. In Essex, however, on a soil of peculiar excellence, wheat and beans were tried for 36 years in succession, and continued profitable during all that period. There are many farmers in the neighbourhood of London also, who obtain three crops, every two years, as, 1. Winter tares and turnips; and, 2. Corn, generally wheat; and preserve their land in as clean and rich a state as could be desired. This system is more profitable than any other, and may be found applicable to a larger proportion of the southern districts of England, than is commonly imagined ([253]).

We shall now proceed to consider, what may be properly called a rotation, where the course commences with a cleansing crop.

Three Years' Rotation.—Mr Mundy, in Derbyshire, has adopted with success the following course: 1. Swedish turnips; 2. Barley; 3. Clover ([254]). But the most productive course of cropping, for a period of three years, commencing with what may be called, under proper management, a cleansing crop, was that adopted by Mr Greenhill, in Essex: 1. Potatoes; 2. Wheat; 3. Clover. He manured amply for potatoes, of which he raised from eight to ten tons: his wheat usually produced about forty bushels; and he commonly had four tons of hay per acre. This system has been successfully repeated, on the same soil, for thirty years, and has been adopted by a great number of other farmers in his neighbourhood ([255]).

Four Years' Rotation.—Under this head, the first to be pointed out is, the course known under the name of the Norfolk system; namely, 1. Turnips; 2. Barley; 3. Clover; 4. Wheat. This rotation, however, is not found sufficiently meliorating; for without a plentiful supply of extra manure, and deep ploughing, both the turnip and the clover crop will often fail, unless the land is refreshed by grass, for at least two or three years. To obviate this difficulty, it has been proposed to begin with, 1. Winter tares, followed by turnips, and both fed upon the land by sheep. The soil, thus enriched, will produce, 2. Wheat; 3. Clover; and 4. Barley, or oats, in succession ([256]).

In Scotland, on turnip soils, the following rotation has been found to answer: 1. Turnips; 2. Winter wheat, sown in spring ([257]), or barley; 3. Clover; and, 4. Oats, introducing partly winter wheat after the turnips, and oats after the clover. This is certainly a productive rotation, and being recommended by farmers, justly accounted among the first in their profession, is entitled to attentive consideration ([258]).

Under careful management, a rotation still more severe, has succeeded; namely, 1. Turnips; 2. Wheat; 3. Grass, (mostly sheep-fed); 4. Four-fifths winter wheat sown in spring, and one-fifth oats. Under this course of crops, the produce of a farm has been improved, both in quality and in quantity, since its commencement to the present time, *and continues to improve.* The additional quantity is, to the amount of not less than four bushels per English acre ([259]).

In the neighbourhood of Dunbar, in Scotland, a course distinguished for its severity, has been tried; namely, 1. Turnips; 2. Drilled wheat; 3. Clover; 4. Drilled wheat. It appears, however, that even in a dry and favourable climate, such as that to be found in the lower part of East-Lothian, and the advantage of great quantities of sea-weed, such a rotation could not long be continued on a light soil. The quantity of dung usually applied, was to the amount of about *twenty* two-horse cart-loads per English acre, to the land intended for turnips, whereas only twelve such cart-loads are commonly given by the majority of farmers. The turnips were always eaten on the ground by sheep. The same quantity of dung, or of sea-weed, was also applied on the grass-land before ploughing. Notwithstanding all these advantages, it was found, that wheat could not be grown with success, on light lands, every other year, for any length of time. After practising it for fourteen years, the result was, that though by the force of manure, abundance of straw could be grown every other year, yet the wheat was light and unproductive. Instead of the second crop of wheat, therefore, oats were preferred ([260]).

The rotation of four crops, adopted near Edinburgh, namely, 1. Potatoes; 2. Wheat; 3. Clover; and, 4. Oats, is a very productive one, but is only calculated for the neighbourhood of great towns, where there is an ample command of manure, of a superior quality, and a demand for potatoes. It appears from the experience of that neighbourhood, that there cannot be a better preparation for wheat than potatoes, nor one more valuable in respect to produce, and that the crop of clover afterwards, is abundant ([261]). It has been objected to that system, that potatoes, instead of enriching, rather exhaust the soil, and tend to render the ground so loose and open, as to endanger the crop of wheat being thrown out of the ground during the frosty season. But the practice is attended with this advantage, that the crop is less apt to suffer from the rust, the injurious strength of the dung being exhausted by the potatoe crop, and that by rolling, the risk of the crop being thrown out, may be prevented.

In regard to the practice of raising one, and in some cases, two crops of wheat in the four years' rotation, Mr Blaikie remarks, that growing so exhausting a crop as wheat so frequently, can only be successfully adopted, where the land is of a superior quality, and adjoins large towns, whence street dung can always be had in abundance, and at a reasonable rate; but on inferior land, where that means of restoration is wanting, ought never to be attempted. Street dung is certainly the best restorative to over-cropped land, for it contains more of the elements of food for plants, than any other manure in common use. Copious dressings of farm-yard dung, will force abundance of straw, but will not restore over-cropped land to such a state of fertility, so as to be productive of grain; whereas street dung, under similar circumstances, produces both straw and corn in abundance.

Five Years' Rotation.—Rotations *of five crops*, have in many cases been recommended, both for strong and light lands.

The following system has been long practised in the neighbourhood of Glasgow: 1. Potatoes; 2. Wheat; 3. Grass;

4. Pasture; 5. Oats. In this course, there were only two crops of corn, to three of green crops; and it was ably maintained, that when farmers should be convinced, that they would be as well paid by cultivating food for the use of cattle as for man, (from the increased quantity of manure procured under that system), the importation of corn into this country, would cease to be necessary. It is a safe maxim, that grain should only be sown, when the ground is laid down to grass, or ploughed from it ([262]).

Upon mossy or peaty soils, after effectual draining, the following course is recommended; 1. Potatoes; 2. Rye; 3. Clover; 4. Pasture; and, 5. Oats, barley or big ([263]). Peaty soils however, are apt to get puffy by tillage, and require, in general, pasture to consolidate them. They cannot bear to be much exposed to drought, and they ought to be kept level and close on the surface, and overshadowed with the crop they bear. When nearly broken up, drilling and hoeing ought to be avoided, as it is apt to convert the peat into hard granulated matter, unfavourable to vegetation.

An experienced farmer in Huntingdonshire, considered the following course of crops preferable to every other: 1. A cleansing crop, of whatever kind, as best suited to the soil, as turnips, tares, or cole-seed, to be hoed, but not to stand for seed; 2. A crop of white corn, of the kind best suited to the soil, to be laid down with seeds; 3. Clover, either grazed or mown; 4. Beans, where suited to the soil, to be sheep-fed and hoed, or some other meliorating crop adapted to the soil; 5. White corn suited to the soil. He contended, that however various the soils, and however different in their nature, the same order or course of cropping ought to be pursued, (fen lands always excepted), changing only the species of the corn and vegetables, and adapting them to the nature of the soil to be worked upon, and the demand in the market, for the articles that are cultivated ([264]).

It is obvious, that by such a system of cropping, a soil of tolerable natural richness, might not only be supported without foreign aid, but might increase in fertility. A certain degree of richness, however, is sufficient to produce maximum crops of grain. Land may be too rich, as well as too poor, for growing corn. The injudicious application of a few cart-loads of manure, per acre, more than was required, has often rendered crops of wheat of little or no value. Upon lands made too rich, corn is very apt to lodge, which not only injures the crop of grain, but likewise destroys the clover and artificial grasses sown along with it ([265]).

Six Years' Rotation.—Rotations of six crops, *are peculiarly calculated for large farms.* On small farms, and even large ones near great towns, where manure can be had in abundance, a succession of two, or of three crops, may be safely adopted ([266]). But on large farms, a variety of articles ought to be cultivated, by which the risk of loss, either from the weather, or the markets, is diminished;—fewer horses are necessary;—and the labours of cultivation, can be more equally divided, during all the seasons of the year.

This species of rotation may be considered under the three great divisions, of, 1. Clay lands; 2. Sandy lands; and, 3. Loams.

1. *Clay Lands.*—On wet or adhesive lands, which have been long in cultivation, a fallow, and, in some cases, a fallow-crop, once in six years, are strongly recommended; the favourite rotation being, 1. Fallow, winter tares, Swedish turnip, or cabbages; 2. Wheat; 3. Clover; 4. Oats; 5. Beans; 6. Wheat. In Suffolk, the years for producing the clover and the beans, are reversed ([267]). But for reasons to be afterwards assigned, clover cannot be too near the fallow.

2. *Sandy Lands.*—A rotation of six, may also be adopted in sandy soils; as 1. Carrots, tares, turnips, or potatoes; 2. Barley, or oats, with seeds; 3. Hay, or soiling; 4. Pasture; 5. Pasture; 6. Oats ([268]). Under that course, such soils become highly productive, and, instead of being exhausted, improve in fertility. The first year's grass ought not to be made into hay, unless where sheep have been fed on the ground with the turnip crop, or the land is in good heart. Indeed, if the soil be thin, it should be pastured during the whole three years that it carries grass.

3. *Loams.*—On this species of soil the following plan is recommended; 1. Turnips, or fallow; 2. Wheat, or barley ([269]); 3. Seeds, either clover alone, or clover and rye-grass, with the addition of a little yellow or hop clover; 4. Oats; 5. Tares, pease or beans; 6. Wheat ([270]).

Rich loams, adapted to this productive rotation, will pay the highest rent of any, more especially when early oats are sown after clover; for invariably, on all friable soils, that grain is the most beneficial of crops, seldom producing less than 60 Winchester bushels per English acre, and much more profitable than wheat, which is apt to be blighted.

By this plan also, the crops are divided in a most advantageous manner. All the most valuable grains are grown, without any being twice sown in the same course, except a little barley, owing to a part being sown with it, after the turnips latterly consumed. Some farmers sow early oats after turnips, more especially in the northern districts, where oats are much in demand. But barley generally answers best to sow late after turnips, and oats are found on many soils, to succeed worse after turnips than any other grain. Besides, clover seldom succeeds with oats, rather better with barley, but usually the best with wheat sown in spring. Amongst barley, if not lodged, it will succeed; but from the rich state of the land, that species of crop is apt to lodge, (which circumstance ruins the seeds), except sprat or battle-door barley be sown, which seldom falls down. Grass-seeds rarely fail among spring sown wheat, which is not so apt to lodge as winter, or autumnal-sown wheat, or perhaps any other grain. It is proper to add, that as the wheat is sown earlier than the barley or oats, so is the clover, and this early sowing secures moisture, and promotes vegetation.

Seven Years' Rotation.—The following rotation is adopted in some of the rich deep soils of Suffolk: 1. Turnips; 2. Barley; 3. Beans; 4. Wheat; 5. Barley; 6. Clover; 7. Wheat. Under that system, the crops are said to be productive; the land to be clean, and to have the neatest possible appearance ([271]).

Eight Years' Rotation.—Upon rich loams and clays, or where there is abundance of manure at command, a course of eight crops has been strongly recommended: 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; and, 8. Wheat, or oats ([272]). This rotation is calculated to insure an abundant return throughout the whole period, provided dung be given to the clover stubble. Without that supply, the system would be crippled, and only inferior crops would be obtained in the concluding years of the rotation.

It is proper here to observe, that in these rotations, pease are only once recommended, it being found by experience, that they will not succeed, above once in ten years, consequently, they are chiefly adapted for *protracted rotations*, or soils which are not of sufficient depth for beans, as light turnip soils or thin weak clays. They are most likely to answer, when sown after grass; but even then, the crop is precarious, and is apt to encourage the growth of weeds ([273]).

Double Crops in the same Year.

In the vicinity of the metropolis, and in other parts of England, also in the neighbourhood of Edinburgh ([274]), and near Aberdeen, double crops in the same year, are raised on the same ground, not only in the gardens, but in the fields. There are many farmers near London, who manure for tares, and then have turnips in the same year, and next year wheat, by which they obtain three valuable crops in two years, which average from L.16 to L.20 per acre per annum ([275]). Some farmers grow clover the third year, by which the average annual produce is kept up to nearly, if not quite, L.20 per acre. This system used formerly to be limited to a few fields near the farm-yard; but it is now extended over many whole farms ([276]). In favourable seasons, what are called *stubble turnips*, are likewise occasionally raised ([277]). But these practices, though they may be partially adopted, where they have the advantages of soil, climate and manure, are but rarely calculated for the northern parts of England, or Scotland.

In Flanders, the system of double cropping is carried to a very great extent. On their light soils, they sow carrots in February, on a crop of wheat sown in November, and well manured. In other cases, they sow turnips, after a crop of grain is reaped, slightly ploughing the land for that purpose; also spurry, for feeding milch cows, by which excellent butter is obtained; and with oats they sometimes sow trefoil, or yellow clover, and get one good cutting of that crop, before it is necessary to plough the land. The quantity of manure, which the Flemish farmer derives from these practices, is very great; and he is thereby enabled, to extract so much produce from soils, originally light and sterile, and which would soon revert to their former state of barrenness, without the greatest industry, and the most unwearied attention ([278]). It is unfortunate that so productive a system, owing to inferiority of climate, cannot be adopted, to any great extent, in this country.

Rape has been strongly recommended as an excellent article to be raised as an after crop, being easily cultivated, and the seed being cheap. If rape were sown on good land, immediately after any corn crop is cut, it would afford a good bite for sheep, as winter feed, and the land would be much improved for a succeeding crop of oats. But on the whole, rye is to be preferred. If sown thick in September, upon dry, fertile loams, it stands the winter much better than rape, comes rapidly on in the spring, is excellent food for sheep, and may be stocked in the months of March and April, when green food is scarce and valuable. This practice gives great relief to the pastures, and is the means of securing, an abundance of grass, during the remainder of the season (279).

Questions connected with judicious Rotations.

Before any general deductions are drawn from the preceding observations, it is proper to discuss the following points: 1. After a fallow, on strong land, ought the succeeding crop to be wheat or barley? 2. After clover, are oats, or wheat to be preferred? and 3. What is the best system for improving and preserving the fertility of weak soils?

1. In Essex, and the other southern counties of England, barley, in general, is the usual crop after fallow; and to render strong land better adapted for that plant, the fallow is frequently ploughed *eight* times. It is remarked, that when fallows are limed, the soil is so open, as frequently to throw out the young wheat; and that with barley, dung is often unnecessary, though in general required with wheat. The barley also, might be sown on the winter furrow in spring, and would be a productive and not a precarious crop. The crop of clover afterwards, would likewise be great, if not destroyed by the weight of the barley crop, which is more apt to be lodged than wheat. About thirty years ago, barley used to be the first crop after fallow in Scotland. But *the risk of losing the clover crop*, — the greater profit derived from wheat,—and the difficulty that would be found, to raise a sufficient quantity of that grain, for the demands of the British consumers, if wheat on fallows were universally given up, is unfavourable to the barley system. Besides, if it is necessary to plough the fallow eight times for barley, according to the Essex system, and only six times for wheat, that is a strong argument in favour of the latter practice (280).

In strong soils indeed, which do not admit of a wheat crop succeeding the clover, the best, and almost the only chance for a crop of wheat, is after fallowing and manuring. By some beans have been recommended, when they form a part of the rotation, but even then it would be advisable, that barley should follow the beans, and wheat the fallow, because beans are not always harvested in time to secure a good season to cultivate land for wheat; but a season can always be had for barley, upon the land that has lain ploughed up and exposed to the mellowing influence of the winter frosts. Barley also requires less manure than wheat. On strong land, the following has been found a safe and productive rotation: Oats, beans, barley, fallow, wheat with clover seeds.

It is found, that the land is always better prepared for the reception of small seeds, after a fallow, than after any crop, and that clover, when sown with the crop that comes next after fallow, succeeds better, than in any other part of the course.

2. In the southern districts of England the culture of wheat, on a clover ley, is much practised. The crop however, is liable to great risk, from the depredations of wire-worms; and in the climate of Scotland, it has been clearly ascertained, that oats are a surer and more profitable crop, and that they leave the land in a better condition than wheat. Three methods, however, have been suggested, by which the mischief effected by the wire-worm might be obviated.

The first is, that of ploughing clover in the beginning of July, immediately after the crop of hay is taken off, or the land has been cut for soiling; then sowing it with rape or cole seed, with one furrow, and after eating the crop down with sheep in September and October, sowing wheat. By this plan, the feed in September and October compensates for the loss of the aftermath or pasture;—the ground is more sensibly enriched, than by the usual mode of pasturing;—the soil is brought into so mellow a state, that it can be drilled, if necessary;—while, by the treading of the sheep, any insects in the ground are destroyed ([281]).

The second mode of destroying such insects, is, by delaying ploughing clover stubble till December. If ploughed in October or November, the worms when turned up, are able to creep again into the soil, where they lie dormant till revived by the warmth of spring, and then they prove extremely mischievous. But if exposed, in a torpid state, to the frost, and the inclemency of the season, they are speedily destroyed ([282]).

The third plan is, to sow the wheat, (even winter wheat accustomed to that culture,) in spring, instead of winter. This may be done with success, so late as the beginning, or even the middle of March. The wheat thus raised, is generally as productive in quantity, but seldom so good in quality, as after turnips, pease, or beans. The plan, however, merits attention, as the attacks of worms may thus be got rid of ([283]).

It may be proper here to observe, that by far the larges proportion of the wheat grown in the counties of Northum berland, Roxburgh, and Berwick, is sown in the month of February and beginning of March, upon land that had grown turnips, and upon which sheep have been folded, and even a part of the crop drawn off in alternate rows. The land is thus however sufficiently enriched, and acquires that firmness which is necessary to the production of grain, and more especially for wheat; whereas if that crop had been treated in the usual way, the greater proportion of the plants sown in winter, would have been thrown out, and what remained, would have produced a weak, straggling and unproductive crop. By sowing winter wheat in the clover leys, in spring, the devastations of the wire-worm would be prevented, and an immense addition made to the produce of the country. To give the experiment a fair trial, winter wheat, accustomed to spring culture, from the Lothians or Northumberland, ought to be procured.

3. The best mode of increasing, and preserving the fertility of weak soils is, by having a division of them in pasture, for three, four, or even five years, and then brought in again; so that in the course of a twenty-one years' lease, each division, in its turn, remains in grass for a considerable period of time. In lands which are not naturally fertile and productive, and where town manure cannot be had, this plan must be attended with very beneficial consequences. Every part of a farm, thus derives a proportional share of the advantage of being kept in grass, which is preferable to the plan of preserving one part of a farm constantly in grass, and the remainder under cultivation.

On dry lands adapted for sheep, there is always a return for their food; and the land while in pasture is gaining strength, for another course of crops. There is a great saving in the amount of labour, and the expense of seed, especially clover and the grasses. The crops of grain are more abundant, than when more frequently repeated, and turnips are obtained with less difficulty, when the land on which they are grown is fresh. An eminent farmer in Northumberland, (John Grey, Esq. of Millfield Hill, near Wooler), has, under a system of three years' grass, cultivated a large farm of 1500 acres of dry loam, and with the greatest success. Where that plan is not adopted, the crops of grain will be deficient in quantity, and still more in quality.

General Deductions respecting Rotations.

The following important rules in regard to rotations, are particularly to be recommended.

1. When any farm or district begins to be improved, it is necessary to commence with such crops as are the most likely *to produce manure.* Hence, barley ought to be avoided, as it yields, when compared to other crops, the smallest quantity of straw. Two exhausting crops also, should never be attempted in succession, if the soil has not acquired a considerable degree of fertility, or naturally possesses it, as is the case in regard to alluvial lands. Green crops are greatly to be preferred, as, from their superior bulk, they are more productive of manure, and go farther in supporting live stock. In similar soils and situations, green crops will furnish, at least one-fourth, and in many cases, one-third more putrescent manure, than can be obtained from the straw of corn crops, grown on the same land. After green crops also, the weight and quality of the next crop of corn, are greatly improved, and it fetches a higher price at market.

2. The crops should be so arranged, that the labour of ploughing for each, and of sowing, weeding, reaping, &c. may proceed in *a regular succession;* by which the labour of cultivation is not too much crowded on the farmer, at any one season of the year, nor is any quantity of extra stock rendered necessary. All the crops produced on the farm, may thus be cultivated by the same labourers, (with the exception of hand-hoers in spring and summer, and assistants during the harvest), and with the same cattle ([284]).

3. All forcing crops, or *frequent repetitions of the same articles or species, should be avoided;* as a diminution both in the quantity and the quality of the produce, (except in very rare instances), is the usual consequence. Indeed, in soils of moderate fertility, as they are commonly cultivated, the greater distance at which the repetition of any sort of crop can be kept, whether it be leguminous or culmiferous, the better is it likely to prove ([285]). And,

4. Those crops should be raised, which *are the best calculated for the extirpation of weeds.* The most effectual plan for that purpose, would be, (except on the richest soils), to cultivate *a greater proportion of green crops, than of grain.* By this means also, a constant succession of large products may be secured ([286]).

III. *On the Use of Spade Husbandry in the Cultivation of the Soil.*

In early ages of society, when oxen and horses were cheap, when they were fed at little or no expense, when their stables were little better than miserable hovels, when the wages of ploughmen were low, and when labourers were not sufficiently numerous for carrying on extensive cultivation by *manual labour*, it is not to be wondered at, that the invention of the plough should be accounted a most valuable discovery. But now, matters are materially changed; cattle and horses are dear, their accommodation and food expensive, the implements of husbandry are costly, while labourers are abundant, and their wages low;—hence it has become a most important subject of discussion, to what extent it would be advisable for the farmer, to employ human, rather than animal power, in the cultivation of the soil. It is evident, that in the present distressed state of the country, some great measure ought, if possible, to be adopted, that the unemployed agricultural poor, may be furnished with the means of subsistence, *by their own labour;* for the other classes of the community, will not long be able to maintain them, without having some work in return, and a fatal public convulsion may result, from such a combination of unfortunate circumstances.

In discussing this interesting subject, it is proposed to consider it under the following heads: 1. On what descriptions of soil, spade husbandry may be adopted, with a probability of success. 2. To what soils it is inapplicable. 3. On the improvement of waste lands by trenching. 4. On the improvement of grass land by digging. 5. On the improvement of plantations by trenching. 6. On the advantages of trenching, for clearing arable lands of weeds. 7. On the improvements which have been discovered in the art of trenching. 8. On the field gardening system of husbandry. 9. To what description of occupations trenching is calculated; and, 10. On the cultivation of arable land by the spade.

1. *To what soils Spade Husbandry is applicable.*—The spade husbandry is peculiarly calculated for light and dry soils. From the looseness of their texture, they do not require, either strong instruments, or great exertion. Manual labour therefore, is perfectly sufficient for the production of even abundant crops on such soils. It is indeed by means of the spade, that the cultivation of light soils is brought to such perfection in Flanders. It is there the practice, not only to allow the surface, that has been for seven or eight years employed in the production of various crops, to rest, but to bring up another into action, that has not merely had the advantage of repose, but the enrichment of a considerable proportion

of manure, which, in a soil of a porous nature, cannot fail to find its way below the usual depth of cultivation. To the prevalence of this practice, much of the fertility of that country is to be attributed. Nor is the plan attended with much expense, at least in Flanders, for digging an acre of light land, eighteen inches deep, costs in that country only L.1, 6s.;—strong lands, of the same depth, but L.1 : 11 : 2;—and even when two feet deep, only L.2, 5s. The time employed in the operation is not considerable, for with proper instruments, and some experience, a labourer can dig an acre of light land, eighteen inches deep, in twenty days,—stronger soil, eighteen inches deep, in twenty-five days; and even two feet deep in thirty-five days ([287]).

The trenching system seems to be likewise applicable to sloping land, more especially where the rise is considerable. When ploughed, the labour is severe on the horses, the operation is imperfectly performed, and where furrows are made, water is collected in them, by means of which much valuable soil is carried off. But if the land were converted by the spade into regular horizontal ridges, the soil would in that state be less apt to be carried away by violent rains, and the produce would be more abundant.

2. *To what Soils Spade Husbandry is inapplicable.*—There are some soils to which spade husbandry is not adapted. Wet lands cannot properly be subjected to that process, being frequently full of moisture, and sometimes perhaps totally inundated. The spade is not calculated for stony, gravelly or shallow soils, more especially if incumbent upon chalk, as is the case in Norfolk, and other districts in England; nor can it be employed with advantage in the cultivation of turnips, even upon the most favoured soils, and far less where the crops are principally produced by oil-cake as a manure, and kept up by turnip husbandry and sheep-folding. How could large fields be cultivated by manual labour, or employed in raising turnips, with any fair prospect of success, when it is necessary to seize the precious moment for sowing that plant, which, if neglected, can never be regained? To such a crop, cultivated to any extent, manual labour is inapplicable.

Heavy clays also, cannot be trenched with advantage at all seasons of the year, for the rain in winter makes them too compact, and the heat in summer renders them too hard. On such soils therefore, it can never be carried to any great extent.

3. *On the improvement of waste lands by digging.*—Trench-

ing is by far the most effectual method of reclaiming rugged wastes, and of deepening shallow soils, so as to fit them for every species of cultivation. By this means, all roots and stones are at once removed; the various substances in the soil are mixed together, the inequalities in the surface are reduced, which cannot be so effectually done by the plough, and the land is at once brought into a state of cultivation. This mode of improvement, upon a superficial view, may appear to be the most expensive, and it may be so at first; but it is in the end the cheapest, because it is complete at once, and needs not to be repeated. In fields of ordinary difficulty indeed, two crops will repay the expense of trenching. In one district alone, (Aberdeenshire), not less than 20,000 acres in all, have been added to its cultivated soil, by that process, and probably as much more in other counties in Scotland. By this means, a fine mixed soil is produced, which, *as it contains no weeds*, generally yields, with a sufficient quantity of dung, the heaviest crops of grain.

In Forfarshire, waste lands, which had been previously occupied by trees, or encumbered by stones, are frequently brought, by means of trenching, into the best possible state for future cultivation. After the sterile subsoil is sufficiently ameliorated by exposure to the air, and the application of manures, it acquires great fertility. Trenched soils indeed, when dug to a sufficient depth, are peculiarly distinguished by their fitness to produce deep-rooted, as well as corn plants. Hence red clover thrives particularly well on them, and by that practice, soils with a retentive clay bottom, are fitted for the production of potatoes, carrots, and other large-rooted plants.

In a communication to the author, Mr Warden of Parkhall in Stirlingshire, gives an account of the mode by which he improved some acres of common, in the parish of Muiravonside in Stirlingshire. He divided the land into lots, and let it to different parties of labourers, to be trenched eighteen inches deep, the surface to be levelled, the whins or furze to be destroyed, and the stones to be thrown on the surface to facilitate their removal. The whole expense came to L.9 per Scotch acre, and the labourers, by practice, became so expert, as to make at the rate of 2s. 6d. per day. The result was, that ground taken from a state of nature, and which before, had scarcely yielded a blade of grass, produced at once turnips equal to any in Stirlingshire.

In Dorsetshire, Mr Portman employed a number of labourers in trenching a considerable quantity of waste, covered with furze, for which they were paid, at the rate of L.6 per acre. Land before deemed quite unprofitable, was thus rendered highly productive, and work was provided for the poor, for which they were fairly recompensed.

The spade has likewise been found a most valuable implement for improving moss lands. Mr Allison of Glasnock in Ayrshire, by that means improved land of so soft a quality, that horses could not be employed on it. The expense of delving, the first year, was from L.2, 15s. to L.3; and the second year, from L.1, 15s. to L.2 per Scotch acre, including the expense of drains for carrying off the water. In delving, the ridges were formed about 14 feet wide, and about 35 falls long, and the only manure was from 50 to 60 bolls of lime per acre. In this way, he improved four farms, which had in them much of that sort of soil, and let them, at eight times the rent they had previously yielded.

4. *On the Improvement of Grass Land by digging.*—Among the most successful improvers of the soil by trenching it, Mr Warden has particularly distinguished himself, and he has furnished the following proof, of the great advantages to be derived from trenching grass lands.

During the agricultural distress in 1817, he employed a number of poor people in digging a lawn round his house, and, after producing three crops, 1. Potatoes, 2. Wheat, and, 3. Hay, without any manure, (having been in grass for seven years), he then laid it down in pasture, and in excellent condition, after having thus procured from it three profitable crops, the foundation of which was laid by delving the ground the first year. From his experience, Mr Warden is convinced, that proprietors possessed of lawns and inclosures, intersected with clumps of trees, in many cases covered with moss, *and infected with the foot rot*, may, in the space of three years, be put in possession of ground, producing fine young grass, *perfectly uncontaminated*, and at the same time, preserve the level of their grounds, which they could not do with the plough without great trouble and expense; and by adopting at the same time spade husbandry, a deserving class of people might be employed, during a period of the year, when work is most difficult to be obtained, to the mutual advantage, both of them and of their employers.

5. *On the Improvement of Plantations by trenching.*—In regard to plantations, it is evident, that the ground is rendered more friable by trenching, and is better prepared, to afford room for the young shoots to expand themselves.

Sometimes also it is the practice, on soils which have been trenched for planting, to raise potatoes, and other roots among the young trees. They derive much benefit, not only from the manure employed on such occasions, but also, from the free admission of air and of moisture to their roots.

6. *On the advantage of trenching in clearing Arable Lands of Weeds.*—In 1820, Mr Warden purchased a field of ten acres, which, for the preceding twelve years, had been infested with large *white gowans.* The repeated exertions of different farmers had, in vain, endeavoured, to eradicate that noxious weed. Mr Warden then resolved, to trench the land fifteen inches deep, by which all the weeds were buried, and many thousand cart-loads of stones were thrown upon the surface. The expense was L.9 per acre. After the stones were removed from the surface, the field was dunged, and ploughed. Eight acres were immediately let for potatoes at L.14 per acre, reserving two for turnips. Next year the ground was sown with wheat in the best possible order, and the produce was abundant. By the same means, wild oats, often so difficult to be got rid of, might be extirpated. The seeds of the weeds being generally near the surface, are buried by the trenching process.

7. *On Improvements which have been discovered in the art of trenching Land.*—Mr Blaikie has suggested a plan, which might be adopted, when strong clays are cultivated by the spade. He objects to the customary process of turning over the top-spit, or the cultivated soil, and throwing the barren inert subsoil over it; but he recommends, to turn the top-spit on one side, and to shovel the crumbs of earth upon it. The subsoil in the bottom of the trench should then be dug, without being raised, the top spit of the next trench placed upon it, the crumbs shovelled over it, and the ground carefully levelled, as the work proceeds. By this process, the earth is effectually loosened two spit deep, and the cultivated soil is retained on the surface, a most important consideration in the case of strong clays. Such soils therefore, might thus be cultivated by the spade, to a moderate extent, in every district where population is abundant, and employment difficult to be obtained.

It may be proper likewise to observe, that it is perfectly practicable, to employ the spade, in working land, by women, boys, girls, and even feeble old men, and that occupation may thus be given to paupers of the humblest description. This was ascertained by Mr Falla, who employed girls to trench land, taking two short spits of about 5 or 6 inches deep, the one following the other. The digging was thus done more effectually, than by men at one full spit or spadeful, of from 9 to 10 inches deep. The common wages paid these girls, was tenpence per day, or L.2 : 4 : 4 per statute acre. This is 11s. 4d. per acre, more than by men at one spit, but the superiority of the girls' work, was well worth the difference. By practice also, the difference would become less, and the expense might probably be reduced to 33s. per acre. The girls worked with quite light spades, made for that purpose, about $9\frac{3}{4}$ inches long, 8 inches broad, and weighing, with a light handle, about $4\frac{1}{2}$ lbs. avoirdupois. Thus women, boys, girls, and feeble old men, who are a useless burden on the community, and whose existence is miserable from inaction, may be employed in the cultivation of the soil, or at least in the easier operations of hoeing, weeding, &c. By this means, many of those miserable objects, who are now pent up in workhouses doing nothing, might be enabled to earn a maintenance ; and if such a measure were generally adopted, there cannot be a doubt, that the poor rates in England, might be considerably reduced.

In regard to the employment of the poor, in the operations of husbandry, instead of manufacturing labour, it is to be observed, that there is this essential distinction in its favour, that by cultivating the soil, food, the great object of human labour, is directly obtained, while by industry of any other kind, it can only be procured indirectly, and by means of exchange.

8. *To what occupations of land trenching is applicable.*— It has been justly observed, that though labourers by the day, ought not to have land beyond what is requisite for a cottage garden, yet that labourers by the piece, who are hired occasionally by different farmers, persons who are accustomed to contract for making and repairing roads, or who act as carriers, also millers, and certain country mechanics, as cart and plough makers, ought to have a small possession of land, as a useful appendage to their other occupations. Weavers also, who reside in the country, should have small lots, weaving being a sedentary occupation, and requiring occasionally field labour for the sake of health. It is desirable also, to give lots of land to fishermen, who may often be prevented from going to sea by stormy weather, and to whom that advantage may be a great inducement, to settle in situations calculated for carrying on the fisheries. The inhabitants of villages and small towns also, derive great advantage from the occupation of small lots of land, even though very

heavy rents are exacted for it. They are much better supplied with milk for their families, if they are able, by cultivating a piece of land, to keep a cow, and to raise vegetables, than where they are obliged to go to market for every necessary of life. Their health also, is thus improved; they become more industrious, and are less in danger of devoting their leisure hours to improper objects, when they have every inducement, in the intervals of their labour, to direct their attention, to the little offices and duties connected with their small possessions. As their rent is generally high, that compels them to be industrious, and in particular to pay great attention to the collecting of manure, so that every corner of their little portion of land, is improved in the highest degree.

Spade husbandry may likewise be adopted, where the system of "*Field-gardening*," is practised, by which small lots of land are applied to garden purposes. A cottager on the estate of the late Sir Henry Vavasour in Yorkshire, drew up the following account of a cottage farm, containing three statute acres, cultivated by the spade:

PRODUCE.	VALUE.			A.	R.	P.
240 bushels of potatoes, ...	£.24	0	0	0	2	0
60 ditto of carrots, ...	6	0	0	0	1	0
5 quarters of oats, at 44s. per quarter,...	11	0	0	0	3	20
4 loads of clover, part in hay, part cut green, ...	12	0	0	1	0	10
Turnips, ...	1	0	0	0	0	20
In garden-stuffs for the family, viz. beans, pease, cabbages leeks, &c.	0	0	0	0	0	30
	£.54	0	0	3	0	0

Deduct			
Rent, including house,	£.9	0	0
Seeds, &c.	3	0	0
Value of labour, ...	10	10	0
	£.22	10	0

Profit, L.31, 10s. at market, exclusive of butter, if sold (288).

Under such a system, spade cultivation has its advantages, and the vegetable gardeners in the vale of Evesham, or in the neighbourhood of Biggleswade, would not perhaps substitute the plough for the spade, with profit. But these advantages are owing to peculiar circumstances, and would by no means be applicable to a poor soil, and a scanty produce.

By some it is contended, that all farms under fifty acres of land, should be cultivated by the spade, as such farms cannot afford the expense of keeping a pair of horses; and Mr Warden is of opinion, that where six horses are required, two might be saved by employing labourers to cultivate land with the spade. It is almost incredible, what two able industrious labourers will perform in a year, for only ten shillings per week, or twenty-six pounds per annum each. The original price of the horses,—their annual decay,—the accidents to which they are liable,—the cost of implements,—the bills of saddlers and smiths,—exclusive of the expense of keeping, which cannot be calculated at less than two shillings a-day, or thirty-six pounds ten shillings per annum, besides a ploughman to attend them, all must amount to a considerable sum. It is also to be considered, that while the men and the horses will, in all probability, be unemployed for several days in the year, by bad weather, and other circumstances, the labourer is only paid while he is employed, and for work actually executed.

10. *On the Cultivation of Arable Land by the Spade.*—The advantage of employing the spade, instead of the plough, in the cultivation of arable land, must evidently depend, 1. Upon the produce which they respectively yield; and, 2. On the extent that can be dug by a labourer in any given space of time.

In regard to difference of produce, an experiment was tried in the neighbourhood of Hamilton, expressly to ascertain that point. A field was taken, which had been cropped with beans the preceding year, and the previous year with oats. Two ridges were dug, and two ploughed alternately, and the whole was sown on the same day. A part both of the ploughed and dug, was drilled with the garden hoe. The whole was reaped the same day, and being thrashed out, the result was, that the dug land sown broad-cast, was to the ploughed sown broad-cast, as fifty-five bushels to forty-two; while the dug and drilled, was as twenty and a quarter bushels, to twelve and a quarter upon the ploughed and drilled. The additional grain produced, was not the only beneficial result gained by digging, for in this instance, there was also a great deal more straw, and the land was much more free of weeds, and more easily cultivated next year.

But, notwithstanding the success of this experiment, and though it was strongly recommended to public attention in several periodical publications, it does not appear, that it has ever been attempted by any other individual.

The late Mr Falla, an eminent nurseryman at Gateshead, near Newcastle upon Tyne, tried the plan of spade husbandry on a great scale, and with considerable success: but his successor, it seems, has given up the digging system, finding that ploughing was more profitable.

However practicable therefore, it may be, in particular situations, and to a moderate extent, to cultivate land with the spade, yet there is much reason to question the policy, of attempting to substitute spade husbandry for the plough, in the ordinary routine of agriculture. In populous countries, it is only from the surplus produce of large farms, that the inhabitants of great towns can be supplied with food. But such farms can never be successfully cultivated, nor would the farmer be sufficiently indemnified for his expenses, *unless he had a regular and constant occupation for his stock*, which is quite inconsistent with the idea of great manual aid. Above all, where the farm depends on the culture of turnips, (that sure foundation, in the proper soils, of successful agriculture), the soil could never be properly prepared for the cultivation of that crop, if carried on to any extent, if it depended upon the spade.

It has been justly remarked, that cultivation by the spade would give immediate occupation to a great number of persons who are now unhappily idle, and would for a time relieve the poor's rates;—but that people would soon collect to the spots where employment was found most abundant, and they would necessarily increase in numbers, as the means of living were afforded, so that ultimately, we might be driven to the practices adopted by the Chinese to prevent a redundant population. The object we ought to have in view is, to ascertain, not by what means the greatest possible number of persons can be collected and maintained, but how their employment can be rendered productive of general benefit, by procuring the greatest amount of disposable produce, at the smallest expense.

If we wish however, to preserve that invaluable part of our population who are engaged in the pursuits of agriculture;—who are thence exempted from many disorders, which necessarily result from a crowded population;—whose frames, being accustomed to labour, are better enabled to undergo all the hardships of war;—who are personally interested in the preservation of their country from hostile attacks;—and who have no inducement, like those who depend on "*the* "*exportation*" of manufactures, to prefer foreign to domestic interest;—we will necessarily give, every aid in our power, to the doctrines above promulgated, for there are no other means, by which the essential benefits which have been alluded to, can be acquired, but by employing as large a proportion of our rural population as circumstances will admit of, in the cultivation of the soil, *by Spade Husbandry*, and more especially by improving, under that system, the waste and unproductive lands in the kingdom.

PART II.

ON GRASS LAND.

Introduction.—On the Importance of Grass Land.

The various *grasses*, or herbaceous plants, with which our fields are generally clothed, whether produced by nature or by art, furnish subsistence to a number of animals, subservient to the accommodation and advantage of the human race. From them, man derives food, clothing, and other conveniences, in such abundance, that the skilful management of grass land, is a subject of inquiry, which, next to that of land in arable cultivation, is of the greatest importance to the interests of mankind.

But besides the more immediate importance of grass, (especially since the use of animal food has so much increased), its indirect effect on the production of corn, by communicating additional fertility to the soil, in the alternate courses of tillage and pasturage, is a subject which requires the most serious consideration. It seems placed indeed, beyond a doubt, that the soil, not only obtains a recruit of food, for the nourishment of grain when cultivated, from the decayed herbage rotted on its surface, and the manure it obtains when cattle are pastured upon it, but also acquires a degree of consistence favourable to fertility, while it remains in grass, defended from the variations of the seasons, under the protection of a close carpet.

Fortunately this branch of husbandry, has of late attracted peculiar attention, and a foundation has been laid, for its attaining a high degree of perfection.

On the recent Discoveries which have been made in the Management of Grass Lands (289).

Among the improvements which have been made in the management of grass land, there is none so likely to produce such important consequences, as the discovery of a mode, by which, not only upland pastures, but even permanent meadows of the most valuable description, after being ploughed up, can be completely re-established, in the space of two seasons from the period of sowing the grass-seeds, in their former state of richness and productiveness. A power is thus placed in the hands of every farmer, not only to renovate impoverished soils, but to convert the inert riches accumulated in old, but defective grass land, into valuable corn and bulbous crops, and to reconvert such soils, into improved pasture, as either the interests of individuals, or of the nation at large, may at any time require.

To effect these important results however, it is at all times essential, that the farmer should devote his capital, skill and attention, to the execution of the practical details of this important branch of husbandry, with the same assiduity, which he bestows on the successful culture of the more important crops, as wheat and turnips, produced on arable land. Hence, among other particulars, the following are required; a careful selection or choice of the peculiar kind or variety of the species of plant, that is best adapted to the nature of the soil, and its local climate,—judicious plans for altering the texture of the soil to suit a combination of the superior fattening grasses, as the addition of clay or sand, calcareous substances, &c. — improvements in the local climate, by planting, draining, &c.—a proper preparation of the soil for the reception of the seed,—the due weight or measure of the latter,—careful and seasonable sowing,—and judicious after-management, or mode of culture.

There is one exception however, to this comparison between the successful culture of pasture grasses, with the view of establishing a permanent pasture of the best quality, in the space of two seasons, and that of the successful culture of other husbandry crops, namely, that in the latter, the crop consists of one species or variety only, while in the former, the crop, to be peculiarly productive and nutritive, must consist of many different species, combined in certain proportions, suited to the peculiar texture, and constitution of different soils. A comparison of the composition of the richest natural pastures, with that of such as are of inferior value, proves, without exception, that an intimate combination or admixture, of from at least eight to twenty different species and varieties, of the proper grasses and clovers, are employed by nature, to produce, and keep permanent, the most nutritive and valuable pasture, and consequently, are equally necessary in the formation of artificial pastures. There should also be, an intimate state of admixture or combination, so that two individual plants of the same species, do not stand without an intervening plant of another and different species. The number of plants, or seeds sown likewise, should not be less than from five to ten, on every square inch of the surface; and every square foot should contain, from eight to twenty different species of the proper grasses, and of clovers. Such are the more essential points of difference that demand attention, in comparing the details of culture of the permanent pasture plants, and those of husbandry or farm crops in general, which are of short continuance in the soil, chiefly for one or two years only, and accordingly, unless ample and accurate attention to those particulars be given, the success will be incomplete.

The chief properties which give value to a grass are, nutritive or fattening powers,—weight of produce,—early growth,—reproductive powers,—quick growth after being depastured or mown,—and the facilities it offers for propagation by seed. If one species of grass could be discovered, that possessed all those properties, in a degree greatly superior to every other, then the knowledge of distinguishing the different species of grasses from each other with certainty,—that of the nature of the soils and subsoils best adapted to their growth,—the comparative value and merits of the different species,—with an accurate understanding of their natural habits, including the time of ripening the seed, and the properties of the seed, in reference to harvesting and culture afterwards, might all be considered, rather matters of curiosity, than objects of utility, that require as much attention from the farmer, as the details of the culture of the wheat crop, or of the more essential green crops. But minute and careful culture of each individual plant, that constitutes any prominent part of the produce of the richest, and also of the secondary natural pastures and meadows, has proved ([289]), that not one, or even several species of grasses, possess all these properties in a superior degree, but that they are dispersed among a great many, to the number of from eight to twenty different species. Indeed, if one or two species of grass, possessed all these properties, and could equal the produce of any rich natural meadow, it would be a subject for interesting inquiry, why nature, for the same purpose, employs so many different sorts.

Division of the Subject.

The different particulars regarding grass, may be comprehended under the following heads: Upland pastures;—grass lands of a medium quality;—permanent pastures;—the proper management of rich grazing lands;—that of natural hay meadows, and the mode of converting their produce into hay;—after-grass, or rowen;—fogging grass-lands—transplanting turf;—cultivated grasses, and the means of consuming their produce, either by soiling, or making it into hay;—tethering stock or hurdling them;—and the conversion of arable into grass land, under the system of the alternate, or convertible husbandry.

1. *Upland Pastures.*

In several districts, where the management of stock is conducted in the most systematic manner, the farmers have greatly improved upland pastures, by drawing surface drains diagonally across the face of the hills, wherever injurious moisture appears. The produce of these pastures is thus rendered, not only more palatable and wholesome, but the waters, by being conducted gently downward, in different small channels, are prevented from cutting those deep chasms in the hill sides, by which, in the times of heavy rain, the mountain pastures are often much injured ([290]).

The next great improvement of which these tracts are susceptible, is that of filling the soil, with the earliest and most productive plants, that will grow in such soils and local climates ([291]). For that purpose the ground, where it will admit of cultivation, ought to be ploughed, and laid down, after being limed, with the grass-seeds best calculated for that purpose. They are enumerated in the Addenda, No. XII.

Among the rules which judicious farmers practise, in regard to the management of upland pastures, the following deserve to be selected: 1. Besides a *ring fence*, the whole valuable pastures should be divided into separate fields and inclosed, as the same extent of land, when sheltered, and properly treated, will feed a greater quantity of stock, and to better purpose, than when in an open and exposed state. 2. Not to overstock upland pastures; for when this is done, the cattle are not only starved, and the quantity of herbage diminished, but the soil is impoverished. 3. When the pasture ground is inclosed and subdivided, the stock ought to be shifted from one inclosure to another, at proper intervals; giving the first of the grass to the fattening, in preference to the rearing stock. This practice tends to increase the quantity of grass, which has thus time to get up; and the ground being fresh and untainted, when the stock return to it, more especially if rain has fallen, they will feed with greater appetite and relish. 4. The dung dropt by the stock, while feeding, should be spread about, instead of being suffered to remain, in a solid body, on the place where it has been dropt. 5. Where the large, and the smaller kinds of stock, are to be fed on the same pastures, the larger species should have the first bite: And, 6. It is not thought in general advisable, to pasture land with a mixed collection of different species of live stock, unless the field be extensive, or unless the herbage varies in different parts of the field; for it is generally found, that the grass produced by the dung of cows and oxen, or of horses, is injurious to sheep, producing grass of too rich a quality, for that species of stock.

There is no mode, by which such pastures are more effectually improved, than by the application of lime, either spread upon the surface ([292]), or mixed with the soil. When to be broken up, it is essential, that the surface should be limed the year before, that the lime may be mixed with the *surface soil* only, as it is apt to sink, if covered deep by the plough. The coarse grasses would, in that case, regain possession of the soil, and the dung afterwards deposited by the cattle, will not enrich the land, in the same manner, as if the lime had been incorporated with the surface only ([293]).

2. *Grass Lands of a medium Quality.*

There can hardly be a doubt, that a much larger proportion of the United Kingdom than is at present so cultivated, might be subject to the alternate system of husbandry, or transferred from grass to tillage, and then restored to grass. Much of the middling sorts of grass-lands, from 200 to 400 feet above the level of the sea, is of this description; and all well-informed husbandmen, and friends to the general prosperity of the country, regret, that such lands are left in a state of unproductive pasturage, and excluded from tillage ([294]).

In consequence of a requisition from the House of Lords to the Board of Agriculture, in December 1800, a very extensive inquiry was made, "into the best means of converting certain portions of grass-lands into tillage, without exhausting the soil, and of returning the same to grass, after a certain period, in an improved state, or at least without injury;" and the information collected by the Board upon that subject, is in the highest degree satisfactory and important ([295]).

From that inquiry it appears, that an acre of clover, tares, rape, potatoes, turnips, cole, or cabbages, will furnish, at least thrice as much food, as the same acre would have done, had it remained in pasture of a medium quality; and consequently, that the same extent of land would maintain, at least as much stock as when in grass, besides producing, every other year, a valuable crop of corn; and this, independently of the value of the straw, which, whether consumed as food for cattle, or as litter, will add considerably to the stock of manure.

In discussing this subject, it is necessary to attend to the following particulars: 1. Whether any previous steps are necessary, before lands in grass are broken up. 2. The proper mode of effecting that object. 3. The course of crops. 4. The manure necessary. 5. The system of management during the rotation. 6. The mode of laying down the land again to grass. 7. That of sowing the grass-seeds; and, 8. The subsequent management.

1. If the land be wet, it is advisable to drain it completely, previous to its being broken up; for it is not improbable, that its being kept in pasture, was partly on account of its wetness.

Land that has been long in pasture, does not require dung, during the first course of crops that is taken after being broken up; but the application of calcareous manure, or caustic lime, in such cases, is always expedient. Sometimes, lime is spread on the ground, before it is ploughed; at other times, when it is either under summer fallow, or a drilled crop of turnips. Marl and chalk also, have been used for the same purpose, with great advantage. The land thence derives additional strength and vigour;—the succeeding crops are much improved;—the soil is commonly so softened in its texture, that it may be ploughed with much less strength than would otherwise be necessary;—and wherever it is restored to grass, the herbage is abundant ([296]).

2. Wherever the soil is not too shallow, nor of a friable nature, or when the turf cannot soon be rotted, if land is to be broken up from old pasture, paring and burning is the proper system to be adopted. However much the loss of the vegetable matter accumulated on the surface, and the substances which it contains, are to be regretted, there is no other means, by which good tilth is speedily procured;—the damage that might otherwise be sustained by the grub, the wire-worm, and other insects, is prevented;—while the soil receives a stimulus, which insures an abundant crop.

Where paring and burning, from any circumstance, cannot take place, the land may be trenched or double-ploughed. This is effected, by means of two ploughs following each other, the first plough taking off a thin surface of about three inches, and the second going deeper in the same place, covering the surface sod with fine mould; both furrows not exceeding the thickness of the vegetable mould or other good soil [297].

If the land is ploughed with one furrow, the operation ought to be performed before winter, that it may receive the benefit of the succeeding frosts, by which the success of the future operations will not only be promoted, but many of the insects lodged in the soil will be destroyed.

When one furrow alone is taken, the best size is, four inches and a half deep, by eight or nine broad. The strain on horses, in ploughing ley land, is mostly from the depth.

3. The rotation of crops to be adopted, when grass lands are broken up, must partly depend upon the soil, the local demand for peculiar kinds of crop or produce, and partly on the manner in which it is prepared for cultivation. As a general principle however, it may be laid down, that unless, by the course of cropping to be pursued, the bad grasses, and other plants indigenous in the soil, are extirpated, and the defects, if any, in the soil, for the growth of the more essential pasture grasses be corrected, and genuine seeds of them be sown, they will, when the land is again laid down to grass, increase and prevail, with more rapidity and effect, than the seeds chosen by the farmer; and the consequence must be, a heavy disappointment in the future crops of grass, perhaps solely, or at least principally attributable, to a previous defective management [298]. It is necessary therefore, to enter into details upon this subject, as applicable to clay;—chalk;—peat;—loam;—and sand.

Clay.—There are two kinds of clay, chiefly distinguished by the excess of *alumine* or pure matter of clay, and of *silex* or impalpable matter of flint, which enter into the composition of each. The former is observed to be more benefited by burning than the latter under ordinary circumstances. The process of conversion, in clayey soils, should in general commence with paring and burning, more especially where calcareous matter abounds in the soil, and the existence of the grub is suspected. The following course may then be adopted: 1. Rape, fed with sheep; 2. Beans; 3. Wheat; 4. Beans; 5. Wheat; 6. Fallow; 7. Wheat, sown with grass-seeds. This may seem severe cropping, but is justified by experience. When old grass clay land is broken up, if the land has not been pared and burnt, the first crop ought to be either oats, or dibbled beans. To do justice to the plan of restoring the land to grass, there ought to be, in all cases, according to the soil, either a naked, or a turnip fallow, before the sowing of grass-seeds be attempted.

But on mellow, loamy clay-land, consisting of fine old grass pasture, where it is thought necessary or advisable to break up such land, it should be done in detached pieces, *so as to suit the convenience of the occupier*, and the following course should be adopted: 1. Autumnal ploughing for oats in spring; 2. Fallow for rape, to be eaten with sheep; 3. Beans; 4. Wheat sown with clover; 5. Clover combined with some of the native grasses; 6. Pasture; 7. Wheat; 8. *Rape* to be partially eaten, and hoed in spring, and to stand for seed; and 9. Wheat with grass seeds.—This is a very profitable rotation, and applicable to the best grazing land in Lincolnshire (300).

Chalk.—Paring and burning is considered in this case to be indispensable, as a preparation for turnips, which ought, where manure can be got, to be raised two years in succession: then barley,—clover,—wheat; and after one or two additional crops of turnips, the land may be laid down with sainfoin to great advantage.

Peat.—On this soil, paring and burning is likewise necessary. Under a judicious system, the greatest and quickest profit is thus secured to the farmer, with advantage to the public, and without injury to the landlord. Draining also, must not be neglected. The crops to be grown on peat soils, are, 1. Rape, or potatoes; 2. Oats; 3. Turnips; 4. Oats or wheat, and, 5. Clover, or grass-seeds. A proper application of lime, where it can be obtained (301), is of the greatest service, in enabling such soils to bring corn to its full perfection.

In the fens of Thorney, &c. the following course was recommended by the late Mr Wing: 1. Paring and burning for rape; 2. Oats; and 3. Wheat with grass-seeds; if the land was safe from water, the Lammas sort, if not, spring wheat. This short course, he contended, preserved the land in heart; and it afterwards produced abundant crops of grass. But long courses, in such a soil, run the land to weeds and straw, with a diminution of quality in the grain (302).

Loam.—The courses of crops applicable to this soil, are too numerous to be here inserted. If the sward be friable, the following rotation may be adopted: 1. Oats; 2. Turnips; 3. Wheat, or barley; 4. Beans; 5. Wheat; 6. Fallow, or turnips; 7. Wheat, or barley and grass-seeds. If the sward *be very tough and coarse*, instead of taking oats, it may be pared and burnt for turnips.

Sand.—On rich and deep sandy soils, the most valuable crop that can be raised is carrots. For inferior sands, turnips, to be eaten on the ground, which is then to be laid down with barley and grass-seeds.

4. According to the improved system of laying down lands to grass, land ought to be made as clean and fertile as possible. With that view, all the green crops raised, ought to be consumed upon the ground; fallow, or fallow crops, ought not to be neglected, and the whole straw of the corn crops, should be converted into manure, and applied to the soil that produced it. Above all, the mixing of calcareous matter with the soil, either previous to, or during the course of cropping, is essential. Nothing generally improves meadows or pastures more than lime or marl. They sweeten the herbage, render it more palatable to stock, and give it more nourishing properties.

5. When turnips are raised upon light land, sheep should be folded on them; whereas, if the land be strong or wet, the crop should be drawn, and fed in some adjoining grass field, or in sheds. If the land be in high condition, it is customary to cart off half the turnips, and eat the other on the ground. But this is not a plan to be recommended on poor soils.

6. It has been disputed, whether grass-seeds should be sown with, or without corn, when permanent pasture is intended. In favour of the first practice, that of uniting the two crops, it is maintained, that where equal pains are taken, the future crop of grass will succeed equally well, as if they had been sown separately; while the same tilth answers for both (303). On the other hand it is observed, that as the land must, in that case, be put into the best possible order, there is a risk, that the corn crop will grow so luxuriantly, as to overpower the grass, and, at any rate, may, in a great measure, exclude it from the benefit of the air and the dews; and where a deficiency of food exists in the soil, the annual crop will leave none for the seedling permanent pasture grasses. If the season also be wet, a corn crop is apt to lodge, and the grass will, in a great measure, be destroyed. On soils moderately fertile, the grasses have a better chance of succeeding, or at least, in proportion to its richness, the sward will be better than that on a poorer soil; but then, it is said, that the land is so much exhausted by producing the

corn crops, that it seldom proves good grass land afterwards (303). In answer to these objections, it has been urged, that where, from the richness of the soil, there is any risk of sowing a full crop of corn, less seed is used, even as low as one-third of the usual quantity; and that a moderate crop of grain, protects the young plants of grass from the rays of a hot sun, and prevents the moisture in the soil from being evaporated.

Where the two crops are united, barley is the preferable grain, except on peat. Barley has a tendency to loosen the texture of the ground in which it grows, rendering it favourable to the vegetation of grass-seeds. On peat, a crop of oats is to be preferred (304). Some recommend sowing grass seeds and rape together, to be fed off by sheep in the autumn.

7. The manner of sowing the grass-seeds also, requires to be particularly attended to. Machines have been invented for that purpose, which answer well, but they are unfortunately too expensive for the generality of farmers. It is a bad system, to mix seeds of different plants before sowing them, in order to have the fewer casts. It is better, to sow each sort separately, for the expense of going several times over the ground, is nothing, compared to the benefit of having each sort equally distributed. The seeds of grasses being so light, ought never to be sown in a windy day, except by machinery, an equal delivery being a point of great consequence. Wet weather ought likewise to be avoided, as the least degree of poaching is injurious. Grass-seeds ought to be well harrowed and rolled, according to the nature of the soil (305).

8. When the corn is carried off, the young crop of grass should be but little fed during autumn, and that only in dry weather, or in frost. The grass should be heavily rolled in the following spring, in order to press the soil home to the roots. It is then to be treated as permanent pasture (306).

By attention to these particulars, the far greater proportion of the meadows and pastures in the kingdom, of an inferior, or even medium quality, may be broken up, not only with safety, but with great profit to all concerned.

Permanent Meadows and Pastures.

There are various sorts of grass-land, the breaking up of which has been objected to, particularly water-meadows, salt, and other marshes;—lands apt to be overflowed by streams or rivers;—and low lying tracts, situated in the valleys of mountainous districts.

The subject of water meadows, has been already so fully discussed, (Chap. 3. Sect. 8. p. 271. On Irrigation), that it is unnecessary here to dwell upon it. It may be proper, however, to observe, that the waters employed for irrigation in England, passing through much fertile land, and being often impregnated with the putrid stores of towns and cities, are commonly rich, and that there is also a ready market for the produce; whereas in Scotland, the water is of a less enriching quality, and the market for the produce is more confined. Hence in Eskdale, where irrigation was introduced by the Buccleugh family, the practice has declined, and though, in one or two instances retained, the water-meadows have in general been ploughed up for corn. Irrigation on slopes, on the catch-work system, however, is increasing in that district ([307]), and will always succeed, where there is a porous subsoil. Indeed, nothing is of more importance to the success of irrigation, than to have the roots of the plants freed from stagnant water, and this is of more importance than the quality of the water.

The marsh lands on the borders of rivers, and along the sea-shores in England, are of considerable magnitude, and not, as in Scotland, of a limited size, and scarcely entitled to any particular notice. In Kent alone, they contain lands to the following extent,

	Acres.
Romney Marsh, - - - - - -	44,000
Borders of the river Stour, - - - - -	27,000
Borders of the Medway, the Thames, the Swale, &c.	11,500
Total,	82,500

They are used either for breeding sheep, or for fattening cattle or sheep, and are thus beneficially occupied.

Land apt to be overflowed by streams or rivers, ought certainly to be embanked, and when protected from inundation, might be brought into cultivation; but unless thoroughly drained, as well as protected, it is perhaps better calculated, for being converted into permanent meadow, than cultivated as arable land.

In regard to low lying tracts, in the valleys of mountainous countries, particularly in chalky districts, it is of such importance to have them preserved for hay, and occasionally for pasture, that it would not be advisable to bring them into cultivation. In such tracts, old meadow land is rarely to be met with, and a portion of it, both to raise early, and to provide late food for stock, gives a great additional value to the adjoining upland.

In order that the reader, may be the better enabled to determine a question so much controverted, we shall proceed to give a concise description, of the nature and quality of the several sorts of land, usually retained in the state of permanent pasture; the conversion of which into tillage, has been so much deprecated; and also a short statement of the advantages which such lands are supposed to possess.

The lands considered as best adapted for permanent pasture, are of three kinds: 1. Strong tenacious clays, unfit for turnips, or barley; which are said to improve the more, the longer they are kept under a judicious system in grass ([308]). 2. Soft clayey loams, with a clayey or marly bottom or substratum ([309]); and, 3. Rich sound deep-soiled land, or *vale land*, enriched by nature at the expense of the higher grounds, and generally lying in a situation favourable with respect to climate ([310]).

The advantages of such pastures are represented in the strongest light. It is affirmed, that they feed cattle to a greater weight;—that they are not so easily scorched by drought;—that the grasses are more nutritive both for sheep and cattle than ordinary pasture;—that milch cows fed upon them give richer milk, and more butter and cheese;—that the hoofs of all animals pastured on them are much better preserved;—that they produce a greater variety of grasses; —that, when properly laid down, they yield a succession of pasture throughout the whole season;—that the herbage is sweeter, and more easily digested;—and that they return an immense produce at a trifling expense.

To break up lands possessing these advantages, it is said, can only be justified by the most urgent public necessity, and to prevent the horrors of famine.

On these advantages, thus briefly enumerated, the following observations are submitted to the reader's consideration.

The superior weight, or extraordinary fatness of cattle, does not seem to be either desirable, or attended with profit. Cattle of a medium size always feed better, and pay better, than the very large or overgrown; and when any species of stock is brought to a fair marketable degree of fatness, all further pampering is an improper waste of food. In regard to old pastures not being affected by dry and warm weather, nor the hoofs of cattle being injured by old turf, these are circumstances of inferior moment, in particular as the hoofs of bullocks, cows, or heifers, are not so easily injured, on any sort of pasture, as to require any precautions for their safety. That old grass is more nutritive, and more easily digested than younger pasture, may be admitted; but these advantages are amply compensated, by the greater tenderness, and bulk of grasses, on new pasture; nor are the powers of digestion of horned cattle so very delicate, as to require any particular attention. Richer butter, or distinguished perhaps by higher flavour, may be procured from old, and even from wild pasture; but new pasture yields a fuller bite to dairy cows, enables them to give greater abundance of milk, and produces cheese of superior quality.

The stock maintained per acre, *on the best grazing lands*, surpasses what could be fed on arable land, unless cultivated for lucern. It is not at all uncommon to feed from six to seven sheep, in summer, and about two sheep in winter. The sheep, when put on the grass, may weigh from 18 lbs. to 20 lbs. per quarter, and the increase of weight would be at the rate of 4 lbs. per quarter, or 16 lbs. per sheep. But suppose in all, only 100 lbs. at 8d. per pound, that would amount to L. 3 : 17 : 10. The wool would be worth about two guineas more, besides the value of the winter keep, and the total may be stated at about L. 7 per acre, got at a trifling expense. Such lands, it is evident, are highly profitable under the present system ([311]).

In regard to lands of the first and second sorts, the *tenacious clays* and *heavy loams*, as they have been brought in a succession of years, or perhaps of ages, into a state of great productiveness, they cannot be ploughed without the risk of injury, unless in the neighbourhood of great towns, where they could be supplied with abundance of manure, if it should become necessary. As to the third sort, however, the *sound deep-soiled vale lands*, they would not only be productive of corn, if ploughed, but if free from stagnant moisture in the subsoil, are admirably calculated *for lucern*, the produce of which would be much more valuable, than any crop of grass in their present state. Without dwelling however, upon that subject, it may be proper to observe, that there are pasture lands of an inferior sort, which are too apt to be confounded with those already described, and respecting the propriety of occasionally appropriating them to arable culture, there can hardly be a doubt. Such lands do not depend upon their intrinsic fertility, but upon *annual supplies of manure*, derived from the arable land in their neighbourhood ([312]).

A question then arises, whether it is most for the advantage of the parties interested, and of the public, that one-half of a farm should be in perpetual grass, and the other half in perpetual cultivation; or the whole alternately under grass and grain, and subjected to the convertible husbandry?

The objections to the division of a farm, one-half into *permanent grass*, and the other half into *permanent tillage*, are very great. The arable is deteriorated by the abstraction of the manure which it produces, if applied to enrich the grass; while a part of the manure thus employed, is wasted; for spreading putrescent substances upon the surface of a field, *if done at an improper season*, is to manure, not only the soil, but the atmosphere ([313]). The miserable crops of corn produced, where this system prevails, sufficiently prove its mischievous consequences.

So injurious is the plan of impoverishing the arable land, for the sake of the grass, that in the opinion of experienced farmers, the landlord loses one-fourth of the rent he otherwise would get, for every acre thus debarred from cultivation; while the public is deprived of $3\frac{3}{4}$ bushels of grain, for every stone of beef or mutton thereby obtained ([314]).

This is a point that cannot be too much inculcated, in a country increasing in population, and which finds it necessary to import foreign grain, for the maintenance of its inhabitants. For with the exception of the richest pastures, arable land is, on an average, superior to grass-land, with respect to furnishing articles of human food, in the proportion of three to one ([315]); and consequently every piece of land, unnecessarily kept in grass, the produce of which will only maintain one person, is depriving the community of food capable of maintaining two additional members ([316]).

Landlords, in many parts of England, are apt to be apprehensive, that their interests may suffer from a change of system ([317]); and it is much to be lamented, that the law scarcely affords them adequate protection for their property against tenants, who are inclined to break through their engagements. Were it not for this circumstance, the interests of the landlord might be sufficiently guarded against injury, by judicious covenants, and by prescribing an improved management. A regular system of convertible husbandry, might thus be established, by which the value of landed property, would not only be greatly augmented, but the true interests of the country most essentially promoted.

The principal objection, to the conversion of old turf into arable land, in a mere agricultural point of view, without touching on the tithe question, arises, from an alleged inferiority in the new, when compared to the old herbage; a complaint, which probably originates, either from the improper choice of seeds, or from giving them in too small quantities, thus favouring the growth of weeds. That objection however, is now completely obviated, by those important discoveries in regard to pasture grasses, which have been already described, and from which it is evident, that it is possible to lay down an artificial meadow, that will soon rival the most valuable natural pasture, in regard to productiveness and utility ([318]). Under judicious management therefore, the finest pastures will be rarely, if ever, injured by the plough. When laid down from tillage into grass, they may not carry, for the first year or two, such heavy cattle as they would afterwards, but they will support *more in number*, though of a smaller size ([319]), which will bring a greater weight of butcher meat to market.

It is certainly desirable, in occupations of from 300 to 500 acres of arable land, to keep *in grass* one or two moderate sized inclosures, containing in all from ten to twenty acres, according to the size of the farm, either near, or at no great distance from the residence of the farmer, provided the soil is naturally calculated for that production, and is thoroughly drained, and improved by manure and cultivation. Such inclosed land may be applied to the following purposes: 1. For feeding cattle and sheep, when there is any difficulty in providing other food;—2. Where ewes may drop their lambs, and where they may be fed with turnips, or any other article in the spring season;—3. As a resource for the stock to feed on, in case of any spring or summer uncommonly dry, such as happened in the year 1810, when it was late in the season before the artificial grasses made their appearance, or could be either cut or pastured; and 4. It is likewise desirable, to preserve some very rich old meadows, in the dairy districts: But with these exceptions, the retaining of any considerable portion of a farm in old turf, or permanent pasture, is highly injurious to the landlord, to the farmers, to the labourers in husbandry, and, above all, to the public, more especially at a period like the present, when we are compelled to admit such immense importations of foreign corn, and when a large proportion of our agricultural population, are driven to the most desperate courses, from the want of employment.

The value of any estate, where the system of permanent pasture has been carried to an unreasonable extent, may be easily and greatly augmented, by appropriating the manure of the farm to turnips and other green crops, and by the adoption of the convertible system of husbandry. Indeed, there are many proprietors of land in England, who are now pining in poverty, from the defective management adopted on their estates, who would soon be rescued from their debts and difficulties, by adopting the superior system of cultivation above described ([320]).

4. *On the Management of rich Grazing Land.*

The rules for the management of rich grazing land, are neither numerous, nor difficult to execute.

1. The sorts of manure, and the season for applying them to grass lands, are first to be considered. Light dressings, such as soot, coal-ashes, peat or wood ashes, lime, malt-dust, &c. are often highly beneficial, if applied in February or March, when the weather is dry enough to admit the application, without poaching the ground; but as they do not suit all soils, their efficacy should be tried by experiments, before much expense is incurred ([321]). As there are strong objections to the application of pure dung to grass lands, (much of its strength being evaporated, from its being exposed to atmospheric influence) ([322]), composts are greatly to be preferred. They may be applied, at the rate of from 30 to 40 cubic yards per acre. To keep grass land in good condition, a dressing to this amount, is required every four years ([323]). The application of unmixed putrescent manure, will thus be rendered unnecessary ([324]), which ought at least to be avoided, in meadows appropriated for the feeding of dairy cows, from its affecting the quality of the milk.

2. Attention to the weeding of grass lands, has been already recommended ([325]). It is likewise necessary to clear them of all rubbish likely to affect the young grass, such as the cones of ant-hills;—sticks and bushes left after hedging, or strewed by the wind;—also, every thing that may injure the stock, if pastured, or that can obstruct the scythe, should it happen to be used.

3. Some farmers maintain, that moles are useful in draining the soil,—in communicating air to the roots of plants,—in raising fresh mould upon grass land,—and in killing worms, which do much mischief by feeding on the roots of grass and corn, and materially injuring those plants. But

where moles become abundant, their destruction is considered of some importance, and a variety of methods have been tried for that purpose. The most efficacious practice however, is to dig them up. Mole catchers usually attack them in the spring, watching them in the fields before sun-rise, and endeavouring to discover, whether one hillock has any connection with another, where the moles are to be found, and what are the best means of accomplishing their destruction. If mole-hills are spread about with a spade, or bush-harrow, the grass will be improved by it ([326]).

4. Rolling was formerly considered as indispensable in the management of grass lands, as it tends to smooth and consolidate the surface;—to prevent the formation of ant-hills;—to promote the growth of valuable herbage;—and to render the effects of drought less pernicious. But *scarifying* the turf with a plough, consisting only of coulters, or harrow-teeth, so that the whole surface may be cut or torn, is to be recommended, as a superior practice, *when the pastures are hide-bound.* That tenacious state, rolling tends to increase; whereas by scarifying, the surface is loosened, and the roots acquire new means of improved vegetation. This operation seems particularly useful, when it precedes the manuring of grass-lands; for if well scarified, the ground is so opened, that any manure spread on it, gets at once to the roots, consequently a small quantity thus applied, goes as far as a larger one, laid on according to the old mode, and without any such previous operation.

5. When land of a retentive quality is pastured by cattle or horses in wet seasons, it receives much injury from their feet. Every step they take leaves an impression, which rain fills with water, and then the hole stands full like a cup. This wetness destroys the herbage, not only in the hole, but on the part which surrounds it, while at the same time, the roots of the grasses, as well as the ground, are chilled and injured. No good farmer therefore, will permit any cattle to set a foot on such land in wet weather, and few, during the winter months, on any consideration. Sheep are generally allowed to pasture on young grasses in dry weather, from the end of autumn to the beginning of March; they are then removed; and it rarely happens, that any animal is admitted, till the weather be dry, and the surface so firm, as to bear their pressure, without being poached or injured.

5. One of the greatest difficulties in the management of old pasture lands is, to prevent that immense growth of

mosses, (*hypna*), by which the finer species of grasses are apt to be overwhelmed. Drainage, and the use of rich composts, are in this case necessary. Harrowing, and cross-harrowing, with a common harrow loaded with a weight, so as to go from one to two inches deep, with a sufficient quantity of the seeds of the superior grasses adapted to the soil, accompanied by some coal ashes, lime (327), or well prepared compost, are the most likely means of destroying the moss, and improving the pasture. Feeding sheep with oil-cake, and allowing them to pasture on the land, has also been found effectual for the destruction of moss, and bringing up abundance of grass (328). But the radical remedy is, to plough up such grass lands, upon the first appearance of moss, or before it has made any considerable progress.

6. Rich pastures in general, should rarely be mown. Many valuable grass-lands have been injured by that practice, for they seldom afterwards fatten stock so well (329). If cut, the mowing should take place early in the season, before the grass-seeds ripen, and the aftermath should only be fed lightly by sheep, whose droppings are more fertilising, and do not scald the crop, like those of black cattle. It is well known that rich grass lands, *when annually mown*, become subject to weeds; the bottom becomes thin and mossy, the white clover disappears, and coarser plants occupy the ground. When this takes place, manure should be applied to replace the nutritive matter of the soil, exhausted by the annual hay crop, and the pasture should be fed, instead of being mown, for the space of two or three years, until the weeds have been subdued, and the finer grasses re-appear (330).

In regard to the plan of mowing and feeding alternately, it is a question much disputed among intelligent agriculturists. By adopting that system, a farmer, it is said, may go on longer, without the application of manure, but his fields, in the end, will be ruined by it. It is contended, that to maintain a proper quantity of stock, the land must be accustomed to keep it, particularly in the case of sheep;—that where land has been used to the scythe, if manured for pastures, it will often produce more grass, but that grass will not, (*cæteris paribus*), support so much stock, nor fatten them nearly so well;—and that old pasture will not produce so much hay, as land that has been constantly mowed; for each will grow best *as it has been accustomed to grow*, and will not readily alter its former habits (331). On the other hand, it is asserted, that many experienced farmers prefer the system of feeding and mowing alternately, as they find, under that system, that the quality and quantity of the hay has been improved; and the pasturage, in the alternate year, has been equally sweet and productive ([332]).

7. It is a most important point to ascertain, in what cases cutting, or feeding, is most beneficial. If fed, the land has the advantage of the dung and urine of the pasturing stock; but the dung being dropt in irregular quantities, and in the heat of summer, when it is devoured by insects, loses much of its utility. If the dung arising from the herbage, whether consumed in soiling, or as hay, were applied to the land, in one body, and at the proper season, the operation would be more effectual. The smother of a thick green broad-leaved crop, continued for any time upon the ground, greatly tends to promote its fertility; and it has been pretty uniformly found, after repeated trials, upon soils of almost every description, that oats taken after clover which has been cut, either for soiling or hay, are superior to the crop taken after clover pastured by sheep ([333]).

5. *Of Natural Hay Meadows.*

There are four descriptions of these meadows:—1. On the banks of streams and rivers; 2. In the neighbourhood of large towns; 3. In the vicinity of the metropolis; and, 4. Meadows in boggy or marshy land.

On the banks of rivers.—Were the sides of rivers, or low flat meadows, judiciously inundated, when the stream is turbid with earth, or manure washed into it from the country through which it passes, they would reach a high degree of fertility ([334]); but being rarely protected by embankments, and frequently overflowed at improper seasons, the soil is often chilled, the best grasses are destroyed, and a worthless herbage becomes substituted in their place. This is particularly the case with common-field meadows, whose drainage is likewise in general neglected. Such meadows produce about a ton of ordinary hay, and let for about 25s. per acre. If they were inclosed, embanked, and properly drained, they would probably be well worth from L.3 to L.4 per acre ([335]).

In some cases, low flat meadows have been improved by the application of sand, at the rate of from 10 to 15 tons per acre; but the sand must be carefully spread, and applied at different seasons, so as to prevent any risk of the grass being smothered by an unequal distribution ([336]).

The advantage of protecting such meadows, from useless, and often ruinous inundations (337), having been already treated of, (Chap. III. p. 285), it is unnecessary therefore, to dwell upon that branch of the subject in this place.

Grass Land near large towns.—The propriety of retaining in perpetual grass, lands situated in the neighbourhood of large towns, is a subject respecting which great diversity of opinion is entertained.

It is admitted, that all land of a proper conformation of soil, and of a moderate altitude, is enriched by remaining in pasture. Every year's growth of the herbage, contributes in part to the enriching of the soil; and as it does not all go into putridity at once, but part of the vegetable matter remains partially decomposed, even in rich land, it accumulates in and over the soil, in the form of black mould, or vegetable earth, which forms the richest food for every species of crop. If lime, or other stimulating manures are employed, they operate powerfully, in reducing that substance, to the more immediate food of plants. When land has acquired a due portion of that enriching vegetable matter, it is in the very best possible condition for yielding, to the greatest advantage, crops of grain and roots; and it is more advisable, to plough up land, that has been thus enriched, for these crops, than to allow it to continue, either convertible into hay, or in a diminished state of pasturage, by which the value of its produce will be most essentially reduced.

It was formerly supposed, that old grass, when properly treated, produced such a variety and abundance of rich herbage, as soon to bring fattening stock to the greatest possible perfection, and that nothing *but age* could produce that fine variety of plants, so valuable in old pastures; but it is now ascertained, that the requisite variety of grasses, can be obtained in so short a period as two years, by raising the seeds of those grasses, and sowing them in land prepared for their reception.

In the vicinity of the Metropolis.—About 70,000 acres of upland, in the county of Middlesex, are said to consist of strong clay, with a mixture of flinty gravel. They are represented as unfit for tillage. On that account they are kept in meadow, and are retained in a productive state, by being manured, about the month of October every year, with rich dung from the metropolis. It is alleged, that this land would be of very little value, if it were brought into cultivation, for it would be difficult to till, and would require expensive teams to subdue it, in the short period of the year when it could be ploughed with success, and that the produce it would yield, would be uncertain; whereas when top-dressed with rich dung from London, this land is stated to be worth of rent, from three to six or seven pounds per English acre, and that some parts of it have, in some particular instances, fetched a rent of L.10 per acre. The average produce is about two tons of hay per English acre.

These opinions, however, may be disputed. The difficulty of tilling this land, cannot be greater than that of other stubborn clay land, millions of acres of which are cultivated every year. The teams that plough other clay land, would till this, and in the periods of the year when such land is ploughed elsewhere. Neither can there be any uncertainty in the produce, more than in other clay land. Were such land in Scotland, with dung at command, these 70,000 acres of clay land, might be rendered *four times* more productive of human food, and would give much more rent than at present. If such land were limed with stone lime on the sward, a year or two before being ploughed, it might yield at least eight or nine quarters of oats per English acre, beans and pease of equal value, or more value, for a second crop, and wheat, at the rate of from five to six quarters per acre, for the third crop; and if then sown with grass seeds, more than two tons of hay might be expected, and the pasture would be better than before. Indeed, by any proper rotation, for six or eight years, with a reasonable supply of manure, judiciously applied, returns equal to those above mentioned, might easily be raised every year; and if turned into pasture, say for three years, and fallowed one season out of twelve, a similar course might be again followed, with the certainty of reaping crops of equal value, for another rotation, while the land would always become richer. By such courses, thrice the number of people might be permanently employed, and an immense addition made to the quantity of human food. To keep 70,000 acres of valuable clay land, situated so near the metropolis, where dung is so abundant and cheap, and where straw, and every species of farm produce sell so high, and to receive in return only two tons of hay per acre, is such wretched management, as ought to be exposed and reprobated.

If the same land were applied to the raising of green crops, what a difference would there be in point of produce! Those very fields, now permanently appropriated to hay meadows, with such miserable returns, might, under proper management, be made to yield from thirty to forty tons of green crops, by which the amount of food from the soil, would be augmented above *fourfold*, not only in quantity, but in effect. The manure also, that would produce such valuable crops is ready on the spot, without the necessity of distant carting; whereas in other districts it must be often carried for a number of miles, for that special purpose.

But we are told, that it is necessary to raise a bulky commodity like hay, as near the place of consumption as possible, *on account of the expense of conveyance;* consequently that the practice of employing land, in the immediate vicinity of London, in raising hay, is not so injudicious as may at first sight be imagined. The answer however, is obvious. London is not only situated on a navigable river, by means of which supplies of any bulky article may easily be obtained from a considerable distance, but rail-roads are now so astonishingly improved, that any objection on the score of distance of carriage, can easily be obviated.

Meadow land for cows, is generally mown two, or even three times in a summer. The grass is rarely permitted to stand till the seedling stems fully rise, the great object, in this case, being, to procure hay of a soft grassy quality. It is generally mown the first time each season, early in May, from two to four weeks sooner than it would be advisable to do, if the hay were intended for the support of horses ([338]). In all other cases, good farmers never think of mowing their meadow lands more than once a year, unless they have, or can easily procure, dung sufficient to cover the ground, immediately after the second mowing. In general, where hay for horses is the object, it is thought most advisable to mow but once, and to feed all the after-grass, with a view of increasing the principal crop of the following year.

The mode of making hay in Middlesex, being considered the most systematic and perfect of any hitherto known, a general account of it, drawn up by that distinguished agriculturist John Middleton Esq., shall be given in the Appendix.

Meadows in boggy or marshy Land.—In many of the hilly and pastoral districts of the kingdom, bog meadows are still considered by the farmer, as an important acquisition. In some cases, the grass is of so soft a quality, that it is difficult to convert it into hay. To prevent its being consolidated in the cocks, it must be frequently opened up, and when the weather permits, completely exposed to the sun and wind;

this sort of grass, being only capable of sustaining a very moderate degree of fermentation.

When the natural herbage however, is of a coarser description, it may be put into small cocks, in rather a green or damp state, so as to go through the process of "*a sweating*" or slight fermentation ([339]). The woody fibres in coarse hay, are thus rendered more palatable and nutritious, while its condition for becoming fodder, is considerably improved: but when any warmth becomes perceptible, if the weather will permit it, the hay should be spread out, and put into large cocks, the moment it is in a dried state ([340]).

In the moister pastoral districts, in the north-west parts of Scotland, *hay-barns* are necessary, the construction of which is as open as possible, for the purpose of *drying*, as well as preserving the hay ([341]). In some of these districts, a curious device has been fallen upon, of making the hay, when dried, into ropes of two fathoms in length, and then twisted twofold. Being thus compressed, less room is required in the barn, and in this shape, it is carried with greater facility, to distant glens, for the use of cattle during stormy weather ([342]).

6. *After-Grass, or Rowen.*

After-grass, in Middlesex, is often let by the farmer, at about 20s. per acre, to be fed off by heavy cattle, till such time as the land, would run the hazard of being injured by their poaching, were they continued in the field. It is well known, that wherever a bullock makes a hole with his foot in a clayey soil, it holds water, and destroys the herbage, which is not quite replaced, till several years after the whole has grown up. When the cattle are removed, sheep are kept till Candlemas. Sometimes they are permitted to consume the whole after-grass, at from 3s. to 5s. per score per week.

In some districts, rowen, or *the second growth of grass*, after the hay is mown in July, is preserved from every species of stock, until the spring months, or the beginning of May, when it is fed with sheep. Where there are no water-meadows, this seems to be the most valuable resource that the sheep farmer can resort to. The value of aftermath, as usually consumed, is inconsiderable, not worth more than from 7s. 6d. to 15s. or 20s. per acre. Tolerable rowen will carry five, in some cases even ten ewes per acre, with their lambs, throughout the most pinching periods of the spring, when the turnips are done, and the forward grasses are not ready. It is therefore well worth from 30s. to 40s. per acre at that period of the year, and in severe and backward seasons, it must prove of still higher value ([343]).

7. *Fogging Grass Lands.*

In the original Report of Cardiganshire, a practice is recommended, to which the term *fogging* is applied. Under that system, fields in pasture are shut up early in May, and continued in that state till November or December, when the farmer's stock is turned in, and continues to pasture, till the May succeeding ([344]). Such management, however, can only be advisable on a soil of the driest nature, which will not be injured by poaching in the wettest seasons.

8. *Transplanting Turf.*

This is a new practice in agriculture, originally invented by Mr Whitworth, in Lincolnshire ([345]), but first carried to a considerable extent, by Mr Bloomfield of Warham, in Norfolk, and thence it has spread to other districts. By this process, a piece of good, clean, rich old turf, which ought principally to consist of fibrous rooted plants, is cut into small pieces, of about three inches square, and placed, about six inches apart, on the surface of ground prepared for that purpose. In this way, one acre of turf ([346]), will plant nine acres of arable land. The pieces of flag should be carefully placed, with the grass side uppermost, and the plants pressed well into the ground. No more turf should be cut, carried, and spread in any one day, than is likely to be planted before night. If the transplanted turf is found deficient in any particular species of favourite plants, as white clover, permanent red clover, &c. the seeds of those plants, should be sown upon the young pasture in April. When the ground is in proper temper, (between wet and dry), the pasture should be frequently well pressed down by heavy rollers, which will cause the plants to extend themselves along the ground, rather than rise into tufts, which otherwise they would be apt to do. No stock should be permitted to feed upon the transplanted pasture, in the first spring or summer, nor until the grasses have perfected and shed their seeds. Indeed the pasturing should be very moderate, until the mother grass-plants, and their young progeny, have united, and formed a compact turf. The expense of this operation is about L.2, 10s. per statute acre, without making any allowance, for the charges incurred by summer fallowing the arable land, on which the turf has been transplanted; nor for the year's rent, poor's rates, and taxes for that year; nor for restoring the land, whence the turf plants were taken, to its previous state ([347]).

This plan seems to be well calculated to promote the improvement of light soils, not naturally of a grassy nature, for the grasses and their roots, being once formed on a rich soil, will probably thrive afterwards even on a poor one, as they will derive a considerable proportion of their nourishment from the atmosphere. For light and gravelly soils therefore, where permanent pasture is desirable, the plan cannot be too strongly recommended; and if it were found to answer on peat, after the surface was pared for the reception of the plants, and burnt to promote their growth, it would be a most valuable acquisition to sheep farmers in many districts of the country.

9. *Cultivated Grasses.*

The advantages which have been derived from the introduction of cultivated grasses, cannot be too highly appreciated. Amidst the variety of natural produce, there must be many plants of an inferior quality, which are rejected by horses, cattle, and sheep. Old turf, on that account, is seldom eaten so bare, as a field where a few selected plants, known to be grateful, salubrious, and nourishing to stock, are alone cultivated. Natural meadow also, often contains plants with narcotic and poisonous qualities, by which cattle suffer much injury. Animals in a wild state, discover, by the smell, when plants are noxious; but stock, when domesticated, pay less attention to the information furnished by this sense; and they are often driven by hunger, to eat plants, which they would otherwise have rejected.

The cultivated grasses to be here treated of, are, 1. Red clover; 2. White clover; 3. Crimson clover; 4. Sainfoin; 5. Lucern; and, 6. Some miscellaneous articles, as yellow clover, rye-grass, &c.

Red Clover.

This variety of grass is peculiarly profitable to the farmer, from the greatness of its produce, and the improvement which it occasions to the soil. Land exhausted by corn, and not accustomed to clover, is always restored to fertility, by the shade, smother, and putrefaction, arising from a weighty crop of this article [348]. It is more calculated however, for strong soils, than for those which are loose and sandy. It will thrive on the former, even when not in a very fertile state, if sufficiently pulverized.

To insure a continuance of this fertility, in succeeding rotations, it is of great advantage, to give a deep ploughing to the summer fallow, or turnip crop that is taken, preparatory to the crop of clover. This has been proved in numerous instances [349].

The cultivation of red clover, is too well known, to require being detailed in this place. The propriety of mixing other seeds with it, has been questioned; though some think the mixture of a small quantity of timothy grass, and cocksfoot, is of great advantage, and more especially of rye-grass, which, being an early plant, serves as a nurse, or assistant, to protect the young clover from the severities of the season [350]. Rye-grass, *if cut young*, is not exhausting; it is rather of use in converting the clover into hay, and it improves the quality of the food, when cut for soiling, bringing it earlier forward [351]. This may render it more necessary in Scotland than in England. It likewise greatly improves the quality of the hay *for working horses*, rendering it more strengthening and substantial.

The most important particulars connected with the culture of red clover are, 1. The soiling process; 2. Converting it into hay; 3. Feeding it; and, 4. Retaining it in pasture.

Soiling.—By this term is meant, the feeding of stock in a house, shed, or fold, with cut green food, instead of making the grass into hay, or depasturing the field.

Various articles are used for that purpose in this country, as tares, lucern, and meadow-grass; also barley, rye, oats, and beans, all in a green state; but red clover, either alone, or mixed with rye-grass, is the substance most commonly applied [352].

Soiling is attended with the following advantages: 1. The saving of land;—2. Advantages to the fences;—3. The saving of food;—4. The improvement of stock;—5. The greater product of milk;—6. Increasing the quantity, and improving the quality of manure;—and, 7. Obtaining a higher value for the produce of the soil [353].

1. *The Saving of Land.*—Exaggerated accounts have been given of the saving of land. Some have contended, that it is as one to seven, if not more. By accurate experiments,

it appears ([354]) that it may safely be stated as one to three, an advantage which of itself is sufficient to recommend the practice, to the attention of the industrious and intelligent farmer.

2. *Advantages to the Fences.*—Where stock are stall-fed, fences are not so necessary, and in this way there may be a saving of land, and a diminution of expenditure. But if the same fences were to be kept up, they are not so liable to injury from the stock maintained, nor from the carelessness of those who are employed to catch them.

3. *Saving of Food.*—Animals destroy in various ways the pasturage on which they feed. A considerable portion is rendered useless by being trodden, or by receiving the excrements of cattle, while the pressure experienced when the animals lie down to rest, is productive of a greater or less degree of injury. Large quantities of the grass also are left to shoot up into long stalks, and are thus comparatively rendered useless. On the whole, the waste is very considerable, and augments in proportion to the richness and productiveness of the soil.

4. *The Improvement of Stock.*—This advantage is applicable to all the different sorts of stock, more especially in dry seasons, when pastures are apt to fail.

Working horses or oxen, derive great benefit from soiling. They are saved the trouble of collecting their food, after their work is over, and run no risk from noxious vegetables, or unwholesome water. They can fill themselves much sooner, and consequently have more time for rest; and they can take their repose much better, in a stable or shed, with plenty of litter, than in an open field, where there are so many things to annoy them.

The experiments of soiling cattle, have been eminently successful. Young steers become more tractable for work; and are exempted from many accidents and disorders to which they are otherwise liable. The size and the symmetry also, to which cattle may be brought, when thus kept constantly sheltered, in a progressive state of improvement, without receiving any check whatever, justify the idea, that such stock, will surpass those exposed to the vicissitudes of climate, and other inconveniences inseparable from the grazing system, though pastured on fields of the richest and most luxuriant herbage ([355]).

Sheep also, will thrive when fed in houses, if their hoofs are attended to, while their wool is much improved in quality, (not being exposed to the extremities of either heat or cold), and they escape several disorders, as the rot, &c. which are so often fatal.

Pigs may be soiled on clover, with much advantage, and for that purpose, there ought to be a patch of clover in the garden of every cottager. But green beans are perhaps a still more profitable article, as pigs are peculiarly fond of them. The Windsor sort are preferred, and the beans should be planted at different times, to insure a regular succession. Horses are also fond of green beans, after being a little accustomed to them; and stall-fed cattle, in general, thrive well on that food.

5. *The greater Product of Milk.*—It is highly expedient to soil milch cows, at least in the middle of the day, that they may not be tormented with flies in the field, nor induced to stand in brooks, or ponds of water, nor in the shade of spreading trees or hedges, by which much valuable manure is lost. Cows are thus kept in a healthier state, and the milk is of superior quality. During the flush of the season, the quantity of milk may be as great from good pastures; but when they begin to fall off, cattle, regularly and abundantly fed in a house, must be greatly more productive for the purposes of the dairy.

6. *Increasing the Quantity, and improving the Quality of the Manure.*—This advantage cannot be controverted. When land is pastured, the dung that falls upon it is destroyed in various ways, and does not go through the process of fermentation, which renders manure so valuable. Whereas, by soiling, not only a greater quantity of rich dung is obtained, but it may be "*manufactured* to more advantage." Besides, dung made in summer, is always superior to that made in winter, for the warmth of the weather promotes a rapid fermentation, and generates several valuable substances, the formation of which, the cold of winter, and the superfluous moisture of that season of the year, in a great measure prevent ([356]). By means of soiling also, clay-land farmers are, in respect of manure, put more on a footing with those who cultivate turnip soils.

7. *Increasing the Value of Land Produce.*—There is certainly no mode, by which cultivated grasses will pay so well, as by soiling. In the neighbourhood of towns, the same land will produce at the rate of from L.20 to L.25 per statute acre, cut for soiling, which would be considered high at L.9 or L.10 if let in pasture. The expense of carting the cut grass, must, however, be deducted.

There are also, some other subordinate advantages attending the soiling system;—as the opportunity which it furnishes of using all the grass grown in plantations or orchards, which often supply early food, before the first crop of clover is ready for cutting ([357]). Cattle, and other stock, are also thus prevented from breaking fences, and getting into fields, where they often do material damage to corn, turnips, and other crops. It is likewise attended, in arable culture, with this advantage, that when clover is cut, the succeeding crop is uniformly better, than when the field is pastured ([358]); and in regard to grass-lands, they are exempted from the mischievous effects of poaching in wet weather. Hence it is, that sheep are a preferable stock to cattle, unless where the soiling system is adopted.

In conducting the soiling process, the following rules are recommended: To give food often, and in small quantities;—to attend to the manner in which the food is eaten by the cattle, reducing the quantity, on the slightest symptom of loss of appetite;—and to be cautious that clover is given sparingly, especially when it is wet, to prevent the cattle from being hoven ([359]). This may be effectually avoided, if care be taken, to mow the clover two days in advance. It is likewise advisable, (unless the cattle have been brought up from their earliest age in houses), to give them the liberty of a yard, in which they may enjoy fresh air and exercise; and when they are fed in stalls, it is indispensably necessary, that they should be kept thoroughly clean, and frequently curried.

That the soiling system is attended with great labour in cutting,—collecting,—and conveying the food, in feeding, and keeping the stock clean,—in carrying the manure to the fields,—and also occasions some expense in buildings, cannot be denied; but surely these objections are amply compensated by the advantages above detailed. In all cases therefore, where the soil and climate are favourable to the practice of soiling, there cannot be a doubt of its utility, and the propriety of its adoption ([360]).

Making Clover into Hay.—This process is quite different from the plan of making hay from natural grasses. In general, the clover ought to be mown before the plants have fully blossomed, or, at any rate, before the seed is ripened, that the full juice and nourishment of the clover may be retained in the hay. By the adoption of this system, the hay is cut in a better season,—it can be more easily secured,—and it is much more valuable. Nor is the strength of the plant lodged in the seed, which is often lost.

The great advantage of converting under-ripe clover into hay, is now beginning to be known. There is more nutritious matter in it; and though the crop of clover, when cut in the early part of the season, may be ten per cent. lighter, than when it is fully ripe, yet the loss is amply counterbalanced, by obtaining an earlier, a more valuable, and more nourishing article, while the next crop will proportionably be more heavy. The hay from *old grass*, it has been justly remarked, will carry on stock, but it is only hay *from young grass*, that will fatten them.

After being cut, the clover should remain in the swath, till it is dried about two-thirds of its thickness. It is then, not *tedded* or strewed, but turned over, either by the hands, or the heads of hay-rakes. If turned over in the morning of a dry day, it may be cocked in the evening. The hay should be as little shaken or scattered about afterwards as possible; and if the weather be good, after remaining for some time, according to the season, in the cock, it may be carted into the stack ([361]).

A crop of clover will yield from two to three tons of hay per statute acre. It sells, in the London market, for about 15s. per ton higher than meadow hay.

A new mode of making hay, originally tried in Lancashire, called "*gaiting*," or "*tippling*," (that is, tying up the grass in small bundles, as soon as it is cut), has been strongly recommended. When the weather is favourable, it may be stacked, by this process, on the fifth day. The expense of binding, and of setting up, costs only 2s. 6d. per acre; and a finer sample cannot be had from any stack of clover, than what it produces. The colour of the hay is beautifully green, and the smell most fragrant ([362]).

On the value of Red Clover as a crop.—With the exception of lucern, and the herbage of rich marshes, there is no crop, by which so much stock can be supported, as clover. It may be profitably employed in fattening sheep in spring, and with this food, they will soon be ready for the butcher. Afterwards, a crop of hay may be got; and two or three weeks after the hay has been taken off, sheep intended to be fattened on turnips, may be turned in, and kept there, until the turnips are ready for them ([363]).

On taxing Clover Seed.—It will hardly be credited, that there is a duty of L. 20 per ton on imported clover seed. No tax could be more impolitic, for the importance of this article to British agriculture can hardly be sufficiently appreciated; and it is in the highest degree impolitic, to discourage, by any duty, however slight, so essential a means of improvement. The taking off the tax on clover seed, would therefore be a great boon to British agriculture, and in particular, would promote the use of that valuable plant, in the poorer and more remote districts of the kingdom. The advantage which the farmers would derive from the proposed reduction may be thus calculated. Every 500 acres of arable land has, on an average, 100 acres annually laid down with clover, at the rate of 12 lbs. of clover seed, which, at 10d. per pound, (the medium price of the last three years,) would cost L. 50. If the tax were taken off, the price of the seed would be reduced to 8d. per pound, making a saving to the farmers, who cultivated 500 acres of arable land, to the amount of L. 10 per annum.

10. *Stacking Hay.*

This important operation is performed, in many parts of England, with peculiar care and dexterity. The stacks are frequently round, and the sides and part of the roof, are brought to the most regular form, by hand-pulling, so that no rain makes any impression upon the stack. The hay thus pulled, is used to top the stack or cock; and, on the whole, answers the purpose better than straw, which is not so pliable, and unless laid on with great attention, is apt to admit water ([364]).

11. *Salting Hay.*

The salting of hay, at the time of stacking, has been practised in Derbyshire ([365]), and in the North Riding of Yorkshire ([366]). The salt, particularly when applied to the second crop of clover, or when the crop has received much rain, checks the fermentation, and prevents moulding. If straw be mixed with the hay, the heating of the stack is still further prevented, by the straw imbibing the moisture. Cattle will eat not only such salted hay, but even the straw mixed with it, more eagerly, than better hay not salted, and also thrive as well upon it. The quantity recommended is, a peck of ground rock salt to a ton of hay. In consequence of being thus treated, hay that had been flooded, was preferred by cattle, to the best hay that had not been salted.

12. *On Tethering Stock, or Hurdling them.*

In some districts of Scotland and Ireland, instead of soiling, they *tether* their stock upon the land [367].

In the Agricultural Report of Aberdeenshire, it is stated, that there are some cases, where the plan of tethering, can be practised with more profit than even soiling. In the neighbourhood of Peterhead, for instance, they tether milch-cows on their grass fields, in a regular and systematic method; moving each tether forward in a straight line, not above one foot at a time, so as to prevent the cows from treading on the grass that is to be eaten; care being always taken, to move the tether forward, like a person cutting clover with a scythe, from one end of the field to the other. In this way, a greater number of cows can be kept, on the same quantity of grass, than by any other plan, except where it grows high enough to be cut, and given them green in houses. In one instance, the system was carried to great perfection, by a gentleman who kept a few sheep upon longer tethers, following the cows. Sometimes also, he tethered horses afterwards upon the same field, which prevented any possible waste, for the tufts of grass produced by the dung of one species of animal, will be eaten by those of another kind, without reluctance. This system was peculiarly calculated for the cow-feeders in Peterhead; as, from the smallness of their holdings, they could not afford to keep servants to cut, or horses to carry home the grass to their houses, to be consumed in a green state [368].

In Ireland, the plan of tethering stock, is strongly recommended, in preference to that of promiscuous pasturage, even though accompanied by a herdsman, or keeper. It is there observed, that both cattle and sheep must thrive better, and feed faster, when they have a fresh bite of grass regularly given them, than when they are permitted to wander over a whole field. This is effectually done, when they are not allowed to range indiscriminately over pasture lands, destroying more than they consume, but when each animal is secured by a tether, to the spot on which he is allowed to feed. By changing this spot, he is enticed to eat, from having a clean and fresh bite, perhaps twice a-day, given him. He does not acquire rambling habits, which exhaust his strength, and prevent his fattening; but becoming docile, he necessarily thrives much better. The pasture also is improved, for the young grass is not bit off *prematurely*, which checks its progress, but remains untouched, till it is ready for consumption.

Some eminent and extensive agriculturists in Ireland ([369]), have practised this system with success, and have produced by it, beef and mutton of the best quality, while their lands have at the same time been materially improved. In other cases, it has been tried with milch-cows, store cattle, sheep, and lambs, with all of which it has completely answered ([370]). By its adoption, it has been found, that land will improve more in two years, than under indiscriminate pasturage, in five; and that at least, one-third more stock may be maintained per acre, under the one system than the other. The reason is obvious, the cattle being better fed, deposit more dung, which falling in a narrow compass, is trodden into the ground, by the time the spot of grass, on which they are tethered, is nearly eaten; whereas, when dung is scattered about, the land is not much benefited by it ([371]).

But though superior to promiscuous pasturage, the plan of tethering cannot, as a general practice, be compared to soiling. The latter is to be preferred, as securing a larger proportion of the crop of grass, of which some part must be injured or destroyed when stock are tethered on it;—as the grass, when cut for soiling, seems sooner to recover, and to grow up more quickly and more equally, than what has been eaten off by the cattle;—as animals consuming grass in the house, are free from the excessive heat of summer, and from the stings of flies, which to them are extremely vexatious;—and as their dung and urine are of much greater value, when preserved in dung-hills or cisterns, and in a state fit to be carried wherever they are most wanted ([372]), than even when trodden into the ground where dropt.

The plan of tethering, however, ought to be kept in view, *as an assistant to the soiling system*;—for where preparations have been made for soiling, and, owing to the coldness or dryness of the season, the clover has made little or no progress, so as to be unfit for cutting, it might be advisable, to try the plan of *tethering*, till the grass is more advanced.

Where tethering is objected to, the plan of hurdling may be adopted, either with natural, or artificial grasses. By this mode of feeding, a portion of land in grass, is inclosed by hurdles ([373]), in which sheep are confined; and as the crop is consumed, the pen is changed to a fresh place, until the whole is fed off. This practice is very extensively adopted at Holkham, and is peculiarly calculated for light and dry soils. Its advantages are, that the grass is more economically consumed;—that the stock thrive better, having daily a fresh bite;—and that the dung which falls, being more concentrated, is more likely to be of use ([374]). An experienced farmer in Berkshire, (Mr Stone of Basildon), consumes all his pastures, in portions divided by hurdles, *with store sheep,* (but not when fattening); by which he estimates that the pasture will go twice as far. He even hurdles his wheat stubbles. In parks, or in the neighbourhood of woods, the sheep, when thus folded, may be littered in autumn, with the leaves of trees, and an addition thus made to the quantity of manure upon the farm. By this system, it is said, that lands in grass, will go twice as far, as when the stock are unrestricted, and can wander at large over the pasture.

If the ground is to be pastured after the first year, it is necessary to sow a variety of grass-seeds with the clover. In Flanders, by means of the application of Dutch ashes, which destroys the vermin so injurious to the crops of the second year, and which often contain a portion of gypsum, the clover remains productive for two years; but as it fails the second year, under our management, it is necessary to supply the vacancy. If it were cut earlier the first year, the crop would be more abundant the next one.

The great object to be kept in view is, to have a variety of grasses, that will flourish at different seasons of the year. For that purpose, the late Mr Bridge of Dorsetshire, recommended a mixture of from six to seven pounds of white clover, as much of marl-grass, the same quantity of hop-clover, and one bushel of the best Devonshire rye-grass. By this means, there is a succession of feed during the season. The hop-clover and rye-grass flourish early in spring; the marl-grass is in perfection in July, when the others go off; and the white clover is abundant in August, and continues during the remainder of the season ([575]).

2. *White Clover.*

On rich dry soils, white clover, (*trifolium repens*), is strongly recommended, for bringing such lands into a state of sward; being accounted the best of all pasture-grasses. It is a beneficial practice, to sow this species of clover with barley, and after pasturing the land for one year, to plough it up for wheat.

3. *Crimson Clover.*

It is a subject of astonishment, that this valuable plant, (the *trifolium incarnatum*), should not have been long ago introduced into this country, and cultivated on an extensive scale. If sown in autumn, after a crop of potatoes or other roots, it produces next spring, a crop fit to be cut for soiling cattle, eight days earlier than lucern, and a fortnight before red clover. Care however must be taken, to have good seed, and not to sow it too deep. It produces two excellent crops in one year, the first of which should be cut, as soon as it comes into flower, and the second will produce a considerable quantity of seed. From its early growth in spring, when other articles for feeding stock with advantage are so difficult to be obtained, it is likely to become a valuable acquisition to British husbandry ([376]).

It is objected to crimson clover, that it is only an annual plant, that it is apt to be injured by frost, and that in damp clayey soils, it frequently perishes in the winter season, when sown in autumn. It is however, well worth trying, on light soils in the mild climates of Devonshire and Somerset, also in the western counties of Ireland, and in the Hebrides, or Western Islands of Scotland, where frost is seldom injurious.

4. *Sainfoin.*

The improvement made by the culture of sainfoin, is very great. Poor soils, not worth more than from 2s. 6d. to 5s. per acre, for any other purpose, will, under this crop, yield from a ton and a half, to two tons and a half, of valuable hay, worth a guinea per ton more than meadow hay equally well cured; besides a considerable quantity of after-grass. It also lasts in the ground, equally productive, for a number of years.

It is unfortunate that so useful a plant, is not more extensively cultivated. The general idea is, that it will only succeed in chalky soils, or on lands resting on limestone; but it would probably thrive on other soils, if they were manured with a large quantity of calcareous matter; more especially on dry and shallow uplands, with a loose stony subsoil. The land ought to be in good order, thoroughly cleared of weeds before the seed is sown, and the accompanying crops should be barley or buck-wheat. An early seed-time ought to be preferred, as the end of February, or beginning of March; for, in dry weather, it does not vegetate. When in its infantine state, it is apt to be destroyed by the fly (377).

Sainfoin is in general sown without being mixed with other grasses, though a small proportion of white clover is considered to be rather beneficial than otherwise (378). It may be disputed, whether sainfoin is equal to clover, on rich soils, but its great value is, that it produces an abundant crop, where clover will not succeed.

5. *Lucern.*

This valuable grass, to reap the full benefit of its great merits, requires a dry, deep and rich soil, which must be thoroughly cleansed, by two or three previous green crops of tares, turnips, or cabbages. It may be sown either broad-cast, which is the usual method, or drilled, nine inches apart, between rows of barley equally distant. It is better to sow it with barley, or oats, thinly seeded, both on account of the profit of the crop, and as the grain furnishes some protection to the plant from the attacks of the fly, which does great injury to it when very young. If drilled, from 12 lb. to 15 lb. of seed per acre will do; if sown broad-cast, not less than 20 lb. will be necessary. It sometimes affords cutting four times a-year, but will generally yield *three* good cuttings in the season. Lucern is much superior to clover for soiling milch-cows, giving no taste to the milk or butter, and one acre is sufficient for three or four cows during the soiling season. In rich land, a quarter of an acre per head, will be sufficient for all sorts of large cattle, taken one with another, but on moderate soils, half an acre is the proper allowance. Lucern requires to be kept thoroughly clean, by hand-hoeing, and scarifying between the drills. All other grasses in the rows should be carefully plucked out (379). If the third kind of land kept in permanent pasture, (the deep-soiled vale land), would answer for lucern, as there is every reason to believe it would, what a treasure there is at the command of the possessors of such soils? In proof of which, it is to be remarked, that in the island of Jersey, since the superior importance of lucern has been ascertained, grass land, of a good staple, has been often dedicated to the culture of that plant. It is trenched by the spade, which is an expensive process, but that is fully counterbalanced, by the certainty of success, the early maturity of the plant, the employment which it furnishes to labourers ([380]), and the great amount of its produce.

6. *Miscellaneous Articles.*

A variety of other grasses, in particular circumstances, might be grown with advantage. The common medick, usually named trefoil, or yellow clover, (*medicago lupulina*), is an useful plant mixed with other grasses, as it comes rapidly forward. Marl, or cow-grass (*trifolium medium*), being more lasting than common red clover, is well entitled to the attention of the farmer, when lands are to remain some time in a state of grass. In America, Timothy-grass, (*phleum pratense*), is the principal growth of their meadow lands; succeeding well in moist soils and situations. It is very productive, and is coming gradually into use in England. It is rather a late grass, in regard to the production of its flower stalks, or culms for the hay crop, but its herbage springs early, and is nutritive. Its coarseness renders it at first objectionable; but the hay is abundant, and very nutritious. On mere bogs, the fiorin yields a great weight of herbage; and is perhaps the most useful plant that such ground can produce. The utility of rye-grass, (*lolium perenne*), has been much disputed, but when stocked hard, and kept down,—or fed with sheep,—or, if intended for hay, cut early, the objections to it are removed ([381]). Cook's-foot (*dactylis glomerata*) is early, hardy, and productive; but it is a coarser plant than rye-grass, and requires even greater attention in regard to being cut soon, or fed close ([382]). It does best by itself, and the time of its ripening, being different from that of clover, it does not suit well to be mixed with that plant. The pasturage which it affords is luxuriant, and particularly agreeable to sheep ([383]). Chicory (*cichorium intybus*) also, is strongly recommended, as hardy;—calculated for the poorest soils;—and adapted even for bogs;—though not fitted to be converted into hay, yet excellent for pasture or soiling;—producing a greater quantity of food for sheep, than any other grass now in cultivation.

There are in all 215 *grasses*, properly so called, which are capable of being cultivated in the climate of Great Britain. Of these, only two have been employed to any extent in making artificial meadows,—rye-grass, and cock's-foot. The Duke of Bedford was thence induced, to institute a series of experiments, to try the comparative merits and value of a number of other grasses, to the amount of 97, the result of which was annexed to Sir Humphry Davy's Lectures, and has since been separately published, with more full details, by an accurate and intelligent author, (Mr George Sinclair,) under whose directions the experiments were carried on.

The result of the whole investigation was, that tall fescue grass *(festuca elatior)*, stands highest, as to the quantity of nutritive matter afforded by the whole crop, when cut at the time of flowering; that Timothy, or meadow cat's-tail grass, (*phleum pratense*), affords most food, when cut at the time the seed is ripe; and that narrow-leaved meadow-grass, produces the greatest quantity of aftermath ([384]).

The paucity of grasses, hitherto cultivated, has been a reproach to the agricultural enterprise of British farmers; but though the catalogue is extensive, the list of those *worth cultivating*, does not exceed from 10 to 12, and of these, some have seeds so chaffy, and others so small, that they can neither be dressed, nor easily sown. Some ripen very little seed, while others are but ill calculated for general soils and situations ([385]).

It may be proper here to add some account of the prickly comfrey, *(symphytum asperrimum)*, an anomalous species of plant, which has been lately introduced into this country from Mount Caucasus. By the experiments tried with this plant in Scotland, it appears likely to prove a valuable acquisition. Indeed there is reason to hope, that when planted in a proper soil, it will equal, if not surpass, for bulk or produce, every other herbage plant in use. It seems to be peculiarly calculated for strong clays; for though the bulk of herbage the first year is not so great, yet the second year the growth is most abundant. At first, cows, horses, and pigs do not seem to relish it, but after they have been accustomed to it for some time, they eat it very freely. When full grown, it becomes coarse and woody, and should be subjected to the flail, like furze or whins, or to the tanner's bark-mill.

10. *Of laying down Arable Land into Grass, with a view of recruiting its Fertility, and on convertible Husbandry.*

It cannot be doubted, that if one-fourth part of the land which at present is sown with corn, for a few years after every rotation or course of crops, were properly laid down in grass, for the purpose of feeding stock, until it should become again fit to bear abundant crops of grain, the practice would be of the greatest benefit both to the farmer, and to the public, as the other three-fourths would be better manured, more easily cultivated, and would produce as much for consumption, as the whole now does. The failure of new crops of grass, is in a great measure owing, either to a deficiency of seed, or to the land being sown, when out of condition, and without an adequate supply of manure; and great tracts have, in these circumstances, been continued under a course of aration, to the impoverishment of the occupiers, and the loss of the public ([386]); whereas improved rotations, and in particular, a greater number of green crops, would enrich any poor, or exhausted arable land.

The laying down a portion of the arable land of the country into grass, is a subject of great importance, which may essentially contribute to prevent any apprehension of scarcity. Indeed nothing would give so much relief to any difficulty with respect to grain, as to increase the number of cows. Milk, used with rice, bread, biscuit, or with pot-barley boiled like rice, or meal or flour, would save a large proportion of the consumption of those articles. Nothing can be substituted so quickly, or so cheaply. Each cow, so used, would save one load of wheat per annum ([387]).

Where the land is laid down to grass in good order, and is worth, in meadow, from 40s. to 50s. per acre, it will keep a cow on two acres and a half. Each cow will give from two to three gallons of milk per day, for twelve, out of thirteen months, allowing one to be dry. The produce may be stated at from L.20 to L.30 per annum, which is more than the land would yield, if in an exhausted state, under corn, and at less expense. After however recruiting its strength in this way, it may be again returned with advantage to arable culture.

But, in general, arable land is converted into pasture, for the purpose of feeding sheep. Various plans have been adopted for that purpose. In Rutlandshire, on dry loams, the following course has been adopted with success: 1. Turnips, or white pease; 2. Barley; 3. Clover; 4. Wheat; 5. Turnips; 6. Barley; and then grass for three or more years. Others recommend, as a more speedy and more profitable system; 1. Tares, and then turnips; 2. Wheat; 3. Clover; 4. Oats; and after a crop of tares and turnips, wheat with grass-seeds for sheep pasture. Such lands are, by these means, much recruited, and will, after a term of years, enrich the occupier, by the superior corn crops which five or six, or even three or four years of sheep-feeding, will enable them to produce ([388]).

It is a great error, in laying down land to grass, to sow an insufficient quantity of small seeds. In general, 12 or 14 lbs. of clover is the usual average allowance; but that quantity ought greatly to be increased. In several instances, land has been laid down with ten pounds of red clover, ten of white, and ten of trefoil, or 30 lbs. in all of small seeds, with the addition of three pecks of rye-grass, per statute acre, and the herbage proved most abundant ([389]). This seems to confirm the doctrine already laid down, respecting the advantages of *a liberal allowance* of seed, when land is laid down to grass, more especially for any length of time. The plants, however abundant at first, will die off, to a proper standard, as they become older.

Another point to be strongly inculcated is, that land intended to be converted from tillage to grass land, must either be dry by nature, or be made so by art, before it is possible to get a valuable crop of artificial grasses. All the best sorts abhor a wet bottom when they are young, and will not root deep enough in it, to bear the vicissitudes of the seasons; and not increasing by the roots as they ought to do, will die, when they have perfected their seed, and leave the land bare ([390]). If however, the soil has been deepened by fallowing, and supplied with manure, the very richest and best of grasses will grow well on such land, and produce generally two, often three, and sometimes four tons of good hay at first cutting, with a heavy aftermath.

In laying down arable land into grass, broad and high ridges were formerly not unusual. In this way, it was said, that the surface was enlarged, and that there was a variety of herbage, according to the diversity of soils and seasons. For instance, if the season be moist, the ridges afford plenty of sweet pasturage and dry ground for the pasturing stock to rest upon; whereas, in the dry year of 1783, it was remarked, that while the ridges were burnt up with drought, the furrows of lands of this description continued in full herbage. Such practices however, are no longer recommended, for it has been found, that the crowns or centres of the ridges become too dry, and the furrows, and ground near them, by far too wet, for the growth of either grain crops or of grass.

It is proper to observe, that in all cases, where the subsoil is retentive, every furrow should have its under-drain, otherwise the herbage, especially in a wet season, will be of a very inferior quality ([391]).

The advantages to be derived from the alternate, or convertible husbandry, cannot be too much dwelt on. None but those who have tried it, can be fully aware of the vast improvement effected, by laying down old ploughed land into grass, as well as converting pasture lands into arable. If one million of acres of old tillage land, were gradually laid down into herbage, and the like extent of old pasture broken up, and put under judicious rotations, it would probably be the means of supplying the public markets, with not less than two millions of stones of beef and mutton additional, and three millions of quarters of grain ([392]). Under that system also, when judiciously conducted, the crops are always abundant, and the soil is kept in a constant state of increasing fertility ([393]).

It is proper, at the same time, to remark, that too much pasture, in a populous country, ought to be avoided. It diminishes the necessaries of life, while it increases and cheapens the luxuries, and its produce is much less efficient, than land when properly cultivated for crops of grain, or bulbous roots, in furnishing subsistence to man ([394]).

On the whole, it has been justly remarked, that the alternate system of husbandry, is the most beneficial to the farmers and to the public. A considerable capital is necessarily required, to commence, and carry it on, and it must occasion some trouble in its execution; but these are circumstances, which indispensably accompany every improved system. If one half of a farm be kept under artificial grasses, and other green crops, as much live stock may often be supported, and fattened upon their produce, as if the whole farm were pastured; while the other half, enriched by the large quantity of dung produced by the consumption of these crops, will furnish as much disposable produce, for supplying the market with the various sorts of grain, as if the whole farm had been sown with culmiferous crops. Hence the superior advantages and greater profit derived, from a conjunction of stock, and of corn husbandry; by the union of which, wherever such a plan is practicable, British husbandry can be more substantially improved, than by any other means that has hitherto been suggested ([395]). It is that fortunate conjunction, which distinguishes the agriculture of this, over that of every other country, and has raised it to that proud pre-eminence which it now enjoys.

PART III.

OF GARDENS AND ORCHARDS.

GARDENING is the most productive and advantageous mode of occupying the soil. It also produces the most refined and luxurious articles of human food, and in some respects the most wholesome. Gardens, as shall afterwards be more fully explained, likewise employ, for their extent, the greatest number of labourers, and furnish the greatest quantity of useful produce, from the smallest space of ground. The greater the extent of land therefore, thus cultivated, the more beneficial to the community, especially in a manufacturing country, where the population is so great in proportion to the extent of its territory.

With gardens, orchards are frequently united; and their productions are often the same. The latter, however, will require a separate discussion.

I. *Of Gardens.*

In the garden, not only fruits of various descriptions, but also roots, pulse, salads, and other culinary vegetables, are raised, each of which has its respective advantages.

Fruits were probably one of the first substances to which men directed their attention, with a view to aliment, though they have now become rather an article of luxury, than of substantial diet. They are produced by nature, in that season of the year, when such substances, with their cooling, refreshing, and diluting qualities, are peculiarly acceptable.

Roots contain a greater proportion of nourishing matter, though in that respect they are inferior to grain. There are above forty different kinds produced in this country; but the potatoe, and the turnip, are the only sorts very extensively cultivated. By using these, less bread and animal food is rendered necessary, and if taken in sufficient quantities, the human frame can be supported by them alone, more especially in youth, or when severe labour is avoided ([396]).

Salads have been considered rather as an article of luxury than of aliment. Some of them, as the lettuce, are valuable for their cooling qualities; but from their narcotic powers, several of them cannot be eaten with safety, unless they are blanched ([397]).

Cabbage, cauliflower and other culinary vegetables, in their natural state, are but little calculated for human food, being hard and difficult of digestion; but by cultivation they are rendered succulent and tender. They contain little nutritious matter, but are useful for counteracting the putrescent and stimulating qualities of animal food. Vegetables of this kind have a laxative tendency, and are useful in summer, to relieve the bowels, when costiveness takes place, which often happens in that season of the year, from the increased discharge by the skin.

A portion of garden ground is also employed in raising pulse, in particular beans and pease, with a view of procuring the more delicate sorts, and much earlier in the season, than could be expected from field culture. The consumption of pulse however, as human aliment, is necessarily circumscribed. In their earlier state, as green succulent food, they are generally acceptable; and even when they have reached maturity, they may be used in soups; but if ground into meal, when fully ripe, they are only calculated for those who have strong powers of digestion ([398]). Some of these vegetables, however, are of immense importance, as a resource in times of scarcity, since two or three crops of them might be obtained, while we are waiting for those of grain.

We shall now proceed to consider, 1. The advantages of gardens in general; 2. The different sorts; 3. The rent of gardens; and, 4. The means of their improvement.

1. *Advantages of Gardens in general.*

These are evident, both from the great number of individuals which they employ, and the immense quantity of valuable produce raised by them.

The quantity of productive labour depending upon the gardens in the neighbourhood of London, is peculiarly great. The digging, hoeing, trenching, harrowing, planting, grafting, pruning, budding, gathering and marketing the fruit, and other productions of the garden, together with the carriage, and the great number of dealers, who either sell the articles at the market, or hawk them about the numerous streets of the metropolis, and adjoining villages, must furnish a very great amount of labour and profit to numerous individuals ([399]).

There are said to be 14,000 acres occupied as fruit and kitchen gardens, for the supply of London with fruit and vegetables ([400]); the average produce of which, even at the present reduced price of the various articles brought to market [401], may be stated at the rate of L.60 per acre, or about L.840,000 per annum. This places the gardener's art in the most favourable point of view, as no other application of land, nor of rural labour, can supply so great a proportion of human food,—or yield so much employment to the cultivators,—or pay so liberally for the labour bestowed on it [402].

In the immediate vicinity of Edinburgh, there are about 500 statute (400 Scotch) acres, employed in gardens, besides those at from six to fifteen miles distance, which occasionally send supplies to the market. The total produce is stated at L.18,000 in all, or L.36 per statute acre per annum [403]. This is considerably less than the average produce of the gardens near London; but the latter are situated in a better climate,—a large proportion of them is employed in the production of luxurious articles,—and they are close to a superior market, where higher prices are obtained,—where greater quantities of suitable manure can be readily procured,—and where more labour can be bestowed with advantage.

In the neighbourhood of Aberdeen, the market gardeners find onions the most profitable article they can raise, procuring for them from L.45 to L.58 per acre, according to the price the article sells for [404]. Carrots yield about half these sums; turnips from L.14 to L.18; and potatoes from L.15 to L.20, according to the crop and season [405].

On the whole, there can be no doubt, that from their higher cultivation, and, (unless under very peculiar circumstances), their greater fertility;—from the higher value of the articles produced, in consequence of either their superior quality, or earlier growth;—and from more than one crop being generally raised in the same year on the same ground, the produce of gardens must be more valuable, than that of arable or pasture land.

From the superior quantity and value of garden produce, it might be supposed, that a larger proportion of the country would be cultivated in that style. But the expenses are so great, that if the price of the articles sold were much reduced, (which would be the necessary consequence of a more extended culture), gardening would be no longer followed as a lucrative profession. Competition has probably already gone as far as it ought; and the consumption of fruits and vegetables in London, comparatively speaking, already far exceeds that of any other part of the kingdom. It is at the rate of 16s. 9d. per head, while that of Edinburgh does not probably exceed from 3s. 6d. to perhaps 4s., according to the season and the quantity supplied.

2. *The different Sorts of Gardens.*

These may be classed under the following heads: private fruit-gardens; — private kitchen-gardens;—market-gardens, either for fruit or vegetables, cultivated by the spade;—field-gardens, chiefly cultivated by the plough;—and village-gardens. The interesting subject of cottage-gardens is discussed in the Appendix, No. 13. p. 45.

1. *Private Fruit Gardens.*—It is fortunate, that a taste for the cultivation of fruit often prevails among the rich. It affords a pure, rational and pleasing amusement; and furnishes inducements to those who are possessed of landed property, to reside on their estates, and to abridge the time which otherwise they might be induced to spend in crowded cities.

Fruit-gardens may be divided into two classes; 1. Those in which fruits are cultivated, which require hot-houses to bring them to perfection; and, 2. Such as raise fruit capable of being brought to perfection, under judicious management, by the ordinary temperature of the climate ([406]). In numerous cases, however, both kinds are united.

The pains taken, and the expense bestowed, in raising fruit, by artificial means, in England and Scotland, are very great, and must necessarily increase in the more northern districts, in proportion as the climate is more severe ([407]). In the construction of *hot-houses*, some improvements have recently been made. It is found a saving of expense, to have the sashes fixed, instead of sliding up and down, which occasions the breakage of glass; air being admitted at the bottom by ventilators in front, and likewise at the top of the back wall.—*Standing-flues* within the house, are also found greatly preferable to the old practice of having the back walls of hot-houses flued like hot-walls; and those flues should be made wider or broader than usual, but not deeper. When flues are of small dimensions, there is not capacity in them for allowing the heated particles of air to expand; and a large proportion of the heat therefore, escapes with the smoke, in a latent state, which is obviated by the greater width. In small hot-houses, where economy is studied, the best kind of flue is made of earthen-ware, the same as used for pots to the tops of chimnies, only somewhat thicker. The pieces are two feet and a half long, and about ten inches in diameter, inside measure. They are laid end to end, and every joint rests upon bricks, with a semicircular hollow made on purpose. Such flues are cheap, and require much less fuel than brick ones.

Steam has been employed for heating hot-houses, being conveyed through the houses by means of cast-iron pipes; but the most recent and important improvement, consists in warming such houses by means of the slow circulation of hot water, in iron pipes, laid horizontally on the floor of the houses.

It may be proper to add, that cast-iron is a very advantageous substitute for wood in hot-houses. It is incomparably more lasting;—its appearance is more light and elegant; and by the proper disposition of columns and screws, rafters are saved, and expense lessened, while all the requisite strength is preserved ([408]).

The heating of walls by flues, is another mode of employing artificial warmth for the production of fruit. Without the aid of this contrivance, peaches and nectarines could very seldom be brought to perfection, in the open air, in such a climate as that of Scotland. They are frequently so constructed, that a temporary glass frame can be raised against them; and they are generally furnished with an apparatus for temporary covers, either of nets, or canvas, or of worsted.

Various devices are resorted to, for protecting the blossom of the more delicate and early flowering fruit trees on the open wall, from the effects of the frosty winds, which often prevail in March, April, and May; but nets made of coarse woollen yarn, with the meshes only large enough, when stretched out, to admit the point of the finger, are preferred ([409]).

The advantages attending the pruning of fruit trees are well known. This operation tends to diminish over-luxuriance, which retards fructification; and by it, free access is given to the air, and to light, which promote the ripening, and augment the flavour of the fruit. The proper time for subjecting fruit trees to this operation is, when the sap is ascending, which is generally early in spring, and when the leaves have fully expanded ([410]).

Peeling the outer bark of fruit-trees, is an ancient practice ([411]), to which the attention of the public has been called, by successful experiments, made on a great scale, in the neighbourhood of Edinburgh ([412]). Three useful purposes are answered by this operation: 1. The stricture of the bark, or its being hide-bound, which frequently impedes the circulation of the sap, is removed. 2. A number of insects, and their larvæ, which have been deposited in the bark, are destroyed, and the young leaves and blossoms are protected from their attacks. And, 3. The trunk has free access to the air, by which it is nourished. It is not advisable, to take off the bark of young trees, or of new branches of old ones, or by any means to destroy, or even to injure the inner bark. When the operation is judiciously performed on old trees, they throw out healthy and bearing wood, more especially when the bark has been cracked or diseased, or has become a shelter for insects.

The same plan has been tried on vines with success; and it may prove a practice highly advantageous in the extensive vineyards on the Continent. It must be done, however, judiciously, both with vines and fruit-trees, for the inner bark must be carefully preserved.

In many cases, particularly in pear trees, cutting out a narrow ring of bark, from one-half to one-third of an inch, quite round the stem, has rendered the crop abundant, which otherwise would have failed ([413]). If the incision be covered with a rag, the hollow will be filled up with new bark in the space of a few weeks.

In many cases, fruit trees are at first planted too deep in the soil. The roots are thus excluded, by a superabundant load of earth, from the beneficial influence of the atmosphere. By a removal of part of the useless covering, leaving only a few inches of loose earth over the roots, vigour has often been restored to the tree.

It is proper to add, that taking off the earth, in a circle of three feet in semi-diameter, round a fruit-tree, throwing in two or three pailfuls of soap suds, that have been used in washing, and then replacing the earth, have a most beneficial effect, in rendering every species of fruit tree productive.

The same system may be successfully applied to currant, gooseberry, and raspberry bushes, and to vines. Indeed, merely throwing the soap-suds on the ground where vines grow, has been found of use.

2. *Private Kitchen-Gardens.*—To those who reside in the country, a well cultivated kitchen-garden, is a most essential object, with a view to health, comfort, and economy. In addition to a due regard to aspect and shelter, it requires attention to the following particulars: 1. Soil; 2. Trenching; 3. Manures; 4. Vermin; 5. Rotations; and, 6. The articles proper to be raised.

1. It is found, that a sandy loam is peculiarly adapted for a kitchen garden, more especially when the grains of sand of which the soil is composed, are small, as by that means the soil is capable of retaining a greater quantity of manure, and of moisture, in dry seasons. A free marl, or a soil with a good

mixture of clay, so favourable to retention of these articles, will likewise be found well calculated for garden culture. The addition of a moderate quantity of oxide of iron, it would appear, is of use in promoting fertility ([414]). It is fortunate however, when a garden contains a variety of soils: as some vegetables require a strong and heavy soil, and do not thrive in a light one. Where the subsoil is wet, draining is indispensable.

2. Preparing the soil, and trenching it to the proper depth, are not always sufficiently attended to in garden culture. The soil ought to be from one foot and a half, to two feet and a half deep, particularly where tap-rooted vegetables are cultivated. The roots can thus, with greater facility, extend their fibres, in all directions, in search of vegetable nourishment, and there is provided for any superabundant moisture which may be occasioned by heavy rains, a reservoir where it is retained till wanted.

3. The species of manure must depend upon the soil. Rotten dung is preferred by gardeners, as, in the course of fermentation, the seeds of weeds, and the larvæ of insects are destroyed; and the more putrid the dung, the greater effect it has in promoting the rapid growth of the plant ([415]). Seaweed, where it can be procured, is an excellent manure for garden crops, in particular for onions ([416]). Soapers' waste, used in moderation by itself, or in a compost with earth, is a desirable manure for garden soils. This substance, not only destroys insects and their larvæ ([417]), but, consisting principally of calcareous matter, every species of vegetables is greatly improved in quality, where it is applied. Cow-dung, mixed with water, is a good manure, when frequently applied in a liquid state. In Flanders, they use no other dung but that of the cow, for peaches, the dung of hogs and horses being of too burning a quality ([418]). The best manure for apple trees, is said to be tanners' bark. A tanner's orchard rarely fails. In the rich garden-ground, in the neighbourhood of London, the application of stone lime in powder would be of singular utility.

4. Slugs and snails are very destructive in a garden. Slaked lime, sifted coal-ashes, saw-dust, or the awns of barley, spread on the surface, or laid in rows, in various places, are useful in destroying them. Salt would probably be still more effectual.

5. Skilful gardeners recommend attention to a rotation of crops, and occasionally fallow portions of their gardens, or lay them down with clover, which seldom fails to restore them to

their former fertility. The most experienced horticulturists are now agreed, that even the currant, gooseberry, and raspberry quarters, should be changed every seven or eight years, and the strawberry ground every four or five years. The chief market-gardeners near Edinburgh, think it essential to adopt a certain rotation of principal crops, to be afterwards stated.

6. With respect to the articles cultivated in kitchen-gardens, there are above eighty different sorts, raised even in Scotland, notwithstanding its inferiority of climate; the mere enumeration of which, with some remarks on their nature, quality, and mode of culture, would fill several pages, and must therefore be omitted in so limited a work as this ([419]).

3. *Market-Gardens cultivated by the Spade.*—The market-gardens in the neighbourhood of London, from the amount and value of their produce, are entitled to peculiar attention. Owing to the natural richness of the soil; the quantity of manure given them;—the labour bestowed on their cultivation; —and the skill with which they are managed,—the produce of those in the immediate vicinity of the metropolis is estimated at from L.100 to L.200 per acre, per annum. As such produce is so unusually large, it may be proper to explain whence it arises.

The gardens situated at the Neat Houses, near Chelsea, in Middlesex, are distinguished for their produce and value; but they have many advantages in their favour. The soil is naturally fertile;—for a great length of time it has been cultivated for kitchen-gardens, and abundantly supplied with dung; —by attention to the sluices, the occupiers can have the command of water;—and being situated in the immediate vicinity of the metropolis, the expense of conveyance is moderate ([420]).

But the place where the greatest quantity and value of produce, are raised from the smallest extent of land, is in the neighbourhood of Blue-anchor-lane, Bermondsey, Surrey. That is effected, by covering, from a third to a fourth part of each garden, with hand-glasses and frames, the former, to assist in forwarding the growth of the articles planted; and the latter to preserve, during the winter season, such plants as are to be placed out in the spring, to succeed the former. Gardens managed at such expense, may well produce to the great amount of even *two hundred pounds per acre per annum.* But when the subjoined statement of the expenses attending the culture is considered, even that produce does not furnish more than an adequate remuneration, for the outlay of capital, and the unceasing fatigue and anxiety of mind attending such a troublesome concern.

Expense of cultivating ten acres of garden ground, where a considerable proportion of the soil is covered with hand-glasses and frames.

Rent of ten acres, at L.10 per acre, per annum,	£.100	0	0
Poor-rates, tithes, and other taxes, at L.8 per acre,	80	0	0
Ten women, on an average, L.52 per annum each,	520	0	0
Four women, at L.20 each,	80	0	0
Five horses, at L.52 per annum,	260	0	0
Two carters, at L.50 per annum,	100	0	0
Manure, seeds, and water,	200	0	0
Baskets, tools, &c.	100	0	0
Market expenses,	50	0	0
Blacksmith's, wheeler's, and carpenter's bills,	100	0	0
	£.1590	0	0
Interest of capital, and profit,	410	0	0
	£.2000	0	0

The produce must be immense, and the prices high, to compensate for such heavy charges, as must be incurred in cases, where 3000 hand-glasses ([421]) and 60 frames, are employed, for securing an early produce.

In market-gardens, where cultivation is carried to the greatest perfection, cauliflowers and cucumbers are raised *under glasses*, and yield large sums. Cauliflowers, when grown early in spring, in a good season, will yield at the rate of L.80 per acre; and cucumbers, when the crop is abundant, and when they are brought to market in warm weather, (which greatly promotes their consumption), will fetch from L.100 to L.120 per acre. Asparagus is also forwarded by means of glasses. Between the glasses, there is generally an intercrop of celery ([422]), which in many cases is continued in the same soils for years. A variety of other articles are likewise raised, as radishes, lettuce, beet, onions, spinage, broccoli, coleworts, or cabbages, either in succession, or intermixed with each other, according to the judgment of the gardener. Of late years, sea-kale has been extensively forced in such gardens, and it brings a high price in the market, from January till March.

Among the crops produced by market-gardeners, that of asparagus, cultivated in the open air, merits particular attention. The general average value of its produce, may be stated at from L.50 to L.75 per acre per annum; but that is the only crop that the soil yields during the season, and it is attended with considerable labour and charges, in the gathering and preparing it for market. The original expense, in laying down an acre of asparagus in a proper manner, cannot be stated at less than L.105, to which ought to be added, the rent of the land before it makes any return. It may remain productive for ten years; but L.10 per annum may be stated, for the expense of labour, and as much, for collecting the article, and sending it to market, besides rent, taxes, interest of capital, &c.

The average produce of market-gardens, of the first and second quality, may be calculated at L.150 per acre per annum; while the average expenses, and probable profit, may be stated as follows:

Rent, tithes, and taxes,	£.20	0	0
Labour,	50	0	0
Teams and manure,	40	0	0
Marketing, and other expenses,	10	0	0
	£.120	0	0
Profit, including interest of capital, &c.	30	0	0
Total,	£.150	0	0

There are many market-gardens, however, in the neighbourhood of London, of an inferior quality, the produce of which, though cultivated by the spade, does not exceed in value above L.90 per acre, and some very inferior soils, not above L.50. The returns indeed, are extremely fluctuating. Some crops may afford large profits one year, from the growth of which, next year, loss may be incurred. The expenses are always great. Indeed there are few pursuits, where, considering the skill and industry applied, less profit is in general made, than that of market gardening.

In various parts of England and Scotland, market-gardens are to be met with, but greatly inferior, in respect of produce and value, to those above described. It requires great industry, and severe labour, to derive much profit from such occupations, where the rents are high; yet many families do subsist, by cultivating from two to ten, and sometimes sixteen acres each, as garden-ground. This is accomplished, by a regular succession of crops in the same year, of which the following examples, as practised in the neighbourhood of Edinburgh, may be adduced.

1*st Rotation.*—Early potatoes, planted in March or April, the ground cleared in June or July, and sown with yellow turnip and cauliflower, or green savoys.

2*d Rotation.*—Early pease, sown in December, January, February, or March. Green savoys and German greens, sown between the rows of pease in spring, to remain for crop after the haum of the pease has been cleared off the ground.

3d *Rotation.*—Early turnips, sown in March or April; the ground cleared in June or July, well manured, and sown with onions, spinage, and lettuce, for winter and spring use ([423]).

The average produce of land, cultivated under these rotations, is at the rate of from L.40 to L.45 per acre. The expense of manure and labour is very great, and without unremitting attention and industry, the market-gardener could not make his business a profitable concern, or even maintain his family with advantage ([424]).

4. *Field-Gardens cultivated by the Plough.*—Some gardeners occupy a large extent of land, and using agricultural implements, are distinguished by the name of "*Farming Gardeners.*" There are not less than 8000 acres in all, in the neighbourhood of London, cultivated by such gardeners, and principally by the plough, instead of the spade ([425]). Their crops commonly are, 1. Early pease, sown in January or February, the price and produce of which vary, but the average may be stated at 40 sacks (four bushels each, in their pods), at 7s. 6d. per sack, or L.15. The haum of these early pease, is nearly equal to hay, and may be moderately stated at L.3; hence that crop produces L.18 in all. 2. The ground is cleared from the pease in June or July, and sown with turnips, which produce above L.20 per acre, when sold in the markets of the metropolis for immediate consumption. 3. When the turnips are sold off, the ground is again ploughed, and planted with collards, or coleworts. If the pease are late, they are generally succeeded by a crop of savoys, or of late cabbages. The annual average produce of land cultivated in this manner, may be stated at L.50 per acre.

The rent of land thus cultivated, does not in general exceed from L.3 to L.5 per acre; for though the labour is cheaper, yet the articles raised by plough culture, are generally large, as cabbages, carrots, turnips, potatoes, coleworts, savoys, &c. and being of great weight, are expensive to convey. Articles of common produce also, will not command such prices as the finer sorts, consequently the returns are not in proportion to the difference of expense, between plough and spade culture ([426]).

Sometimes farming gardeners raise not only vegetables, but grain and grass, in which case, after a crop of early potatoes, and then turnips in the same year, wheat is sown with clover. This is considered to be the most profitable plan that can be pursued by farming gardeners, from the saving in the expense of labour. Where manure cannot be had without difficulty, to carry on a succession of vegetable crops, oats, barley, or green tares, are occasionally taken after the clover, thus refreshing the land, with crops of a varied description.

5. *Farmers' Gardens.*—A garden, under a proper system, is a most valuable acquisition to a farmer, with a view both to comfort and economy. Many culinary articles may be obtained, from a well-cultivated and sheltered garden, which cannot be raised in the field, or will not grow in exposed situations, with equal luxuriance and perfection. Attention likewise should be paid, to the sowing of different articles at various seasons, by which an earlier and a more equal, as well as more regular supply for the table may be obtained. It is also of use, to employ a piece of ground in a garden, for raising cabbages, Swedish turnips, and other plants, to be afterwards transplanted into the fields. The refuse of the garden, may be given with advantage to pigs, and milch cows. At the same time, working in the garden, should always be considered as of inferior consideration to the business of the farm ([427]); and on no account ought the farmer's attention, to be materially drawn off, from his crops of grain and grass ([428]).

The size of the garden ought to depend, not on the extent of the farm, but the number of the family, and on the mode of cultivation, whether by the spade or the plough. In general, from one half, to about three-fourths of an acre, is sufficient, when cultivated by the spade, including a portion kept in grass, in rotation, for the drying of clothes, whether spread on the grass, or hung on lines.

If the ground is cultivated by the plough, according to the system adopted by the farming gardeners near London, the garden may contain an acre with advantage. By substituting the plough for the spade, the work will require less attention; the necessity of having a professed gardener, accustomed to digging, will be prevented, and a considerable expense saved ([429]).

The propriety of inclosing a garden substantially, cannot be too strongly inculcated. A wall of stone or brick, from seven to ten feet high, is the preferable fence, as it answers the purpose, not only of shelter, but of preventing every species of intrusion, even that of poultry, so destructive to gardens, and frequently the source of much irritation, where the garden becomes an object of particular attention. Walls of brick, however, are much to be preferred to those of stone. The brick, when once heated, retains its warmth for some time, often during the space of a whole night, and absorbs all the moisture with which it comes in contact; whereas stone-walls grow cold immediately after sunset: and whenever warm moist air touches a stone that is colder than itself, the heat enters the body of the stone, and the watery particles remain on its surface; and this moisture frequently causes the rotting of the fruit. All walls preserve fruit much better when coped.

The articles raised in a farmer's garden, ought to be of easy culture;—of the sorts best calculated for family consumption;—nor ought some aromatic herbs, or medicinal plants, to be omitted. Fruit-trees may also be reared along the walls, and some in the interior of the garden; for though they may injure the garden vegetables, yet the value of their fruit is generally far greater, than the amount of their pernicious effects ([430]). Gooseberry, raspberry, and currant bushes also, the fruit of which the industrious housewife can manufacture into various articles, and which in particular may in a great measure be the means of superseding the use of foreign wines ([431]), ought not to be neglected.

6. *Village Gardens.*—Round many villages and small towns, gardens of a moderate size are numerous and productive. It is a fortunate circumstance, when manufacturers and mechanics take a delight in them, since their health is promoted by the exercise in the open air, for which an opportunity is thus afforded; while at the same time, any tendency to immorality is greatly checked, by an agreeable and useful means of occupation. The village garden is frequently the retreat of the occupier, in the summer evenings, after the labours of the day, where he agreeably employs himself, in watching over the progress of his crops, and the success of his exertions. In those manufacturing villages, or small towns ([432]), where a number of inhabitants have gardens, a taste for keeping them in good order is prevalent, and few instances of dissipation occur ([433]). In such gardens, not only aromatic herbs, and medicinal plants, are cultivated, but flowers of various sorts are raised, as the carnation, pink, auricula, polyanthus, &c. by the sale of which some money is obtained. The Florist Society at Paisley, in Scotland, is a sufficient proof of the advantage to be derived, from directing the attention of manufacturers to such innocent pursuits. The rearing of beautiful flowers, is found to improve their taste for manufacturing elegant patterns of fancy muslin; while the florists of Paisley, have long been remarked, for the peaceableness of their dispositions, and the sobriety of their manners ([434]).

3. *The Rent of Gardens.*

The most superficial observer must be satisfied, that the value of landed property, has been considerably augmented, by the increase of gardens. From their artificial riches;—their high cultivation;—and their great fertility and produce, the rents afforded, are higher than those derived from arable or pasture land ([435]). The expenses, however, are so great, that the rent, in proportion to the produce, is often moderate.

The rent of common garden ground, in the neighbourhood of Fulham, Turnham-Green, Brentford, and other places near London, is from L.6 to L.7 per acre. Nearer London, and where the ground is rich, the rents rise to L.10; and where a garden has a considerable extent of wall, covered with choice and thriving fruit trees, the rents are, according to the quantity and goodness of the walls and fruit-trees, from L.15 to L.20 per acre. In each of these cases, the rents are exclusive of forcing-houses; and the several gardeners have also to pay for tithes, taxes, and assessments, from one-half to two-thirds of the amount of the rents ([436]).

The rent of the best garden ground near Edinburgh, an. 1814, was, on an average, from L.8 to L.12 per statute acre for rent alone, tithes not affecting the occupier of land in that part of the kingdom. It is remarked, however, that unless the soil and exposure be particularly excellent, the tenant cannot have a profitable bargain at such rents, and that the land is likely to suffer from over-cropping, unless a sufficient quantity of manure can be procured ([437]).

The garden ground at Sandy, in Bedfordshire, rents at from L.2, 10s. to L.3 per acre, subject to the occupier paying tithes, taxes and assessments; and a field manured and cleaned, and in a state fit for producing potatoes or onions, will only let for one year, at from L.5 to L.6 per acre ([438]); while in the neighbourhood of many of the third and fourth rate towns of Scotland, from L.6 to L.8 and even L.10 per statute acre, are often paid for land upon which potatoes, and other vegetables, are cultivated ([439]). In the neighbourhood of sea-port towns, market-gardeners are found peculiarly useful; for nothing tends more to preserve the health of seamen, than a plentiful supply of vegetables, not only when on shore, but to be consumed at sea.

4. *Means of improving the Art of Gardening.*

This greatly depends upon three particulars: 1. Attention to the selection of proper seeds; 2. The establishment of Horticultural Societies; and, 3. A careful examination of the improvements in gardening, discovered in other countries.

1. There is no means, by which the art of horticulture can be more easily, or more effectually improved, than by paying strict attention to the seeds of the plants to be raised. Much injury is frequently sustained, from gross negligence, in regard to that important particular. It is highly necessary, that attention should be paid, not only to the selection of proper sorts, or varieties, but also *to the quality* of the seed used, the manner in which it is prepared for sowing, and the state in which it is kept ([440]). It frequently happens, after an unfavourable season for harvesting the seeds, that serious losses are sustained in the succeeding crops, entirely owing to sowing bad seed. The defect may, in a great measure, be attributed to the cultivator's negligence or ignorance, but perhaps is principally owing, to his not using a very simple expedient, namely, *drying his seed.*

It is well known that in a cold and wet season, when barley is harvested in a raw and damp state, and thrashed in winter, it will not grow in a malt couch, whereas if the same barley is either gently kiln-dried, before it is put into steep for malting, or if it is left standing in the stack till the month of April, and has thus received the benefit of the drying March winds, it will then grow well. The same observation is applicable to wheat, for if it is badly harvested, it will not answer for seed in that year; but if kept in stacks, till the following year, it will become good seed; and the same rule also takes place, in respect to the seeds of culinary vegetables. It is in general in the power of every cottager, however adverse the season for gathering the seeds may be, to preserve seeds from his own garden, sufficient for the succeeding year's cultivation; and though the cottager may not have an opportunity of kiln-drying the seeds before they are stored, yet the same object will be obtained, by exposing his seeds to a gentle heat on the hearth, before the cottage fire. It is not the interest of persons who sell the seeds of carrots, onions, lettuces, &c. *by weight,* to keep those articles in a very dry place, and hence arises the disappointment, and those serious losses in garden crops, which are but too frequently sustained. Whenever any person buys seeds, which are not perfectly sound and dry, they should be dried in the manner above described, before they are sown.

2. The institution of Horticultural Societies is of great importance to the improvement of gardening. A society of

that description was established in London in 1805, which is conducted with much ability and success; in 1809, another was formed at Edinburgh, under the title of "*The Caledonian* "*Horticultural Society*" (441); and one has been lately established in Dublin, which is conducted with great spirit. Institutions of this description must promote horticultural improvements by exciting emulation (442);—by facilitating the communication of the valuable knowledge, often acquired by individual practical gardeners, from the result of their own experience;—and by fostering a taste for horticultural pursuits in every class of society, from the great landed proprietor, to the possessor of a cottage garden (443).

3. Nothing now is wanting, to complete a knowledge in the art of horticulture in this country, but that of sending persons properly qualified, to examine the state of gardening on the Continent, and to promote the introduction of such improvements as can be discovered there, or in other countries (444), in the management of fruits, or of garden vegetables. On the recommendation of the author of this work, that plan was adopted by the Horticultural Society of Scotland, its active and enlightened secretary, Mr Neill, having gone to the Continent for that purpose, accompanied by two intelligent friends. The account he published of this excursion is in the highest degree satisfactory and important (445).

It may be proper to conclude, with congratulating the public, on the important improvements which have been effected in our principal fruits, by crossing the breeds, on the system so fortunately discovered by the celebrated Linnæus. This is accomplished, by gently opening an unexpanded blossom, and, with a pair of fine pointed scissors, cutting out the stamens, (male parts), leaving the stile, (female part), uninjured. When the blossom naturally opens, the pollen or fecundatory powder of another tree, the good qualities of which it is wished to communicate to the one first mentioned, should then be introduced. The seeds which result from this cross impregnation, are sown, and the plants thence produced, generally exhibit the characters of hybrids or mules. Several years must of course elapse, before the qualities of a seedling tree can be duly estimated; but by taking scions from the seedling, and grafting them upon an established wall-tree, the period of probation may be greatly abridged; and by thus crossing some of our hardy pears, apples and cherries, with the finest sorts from Flanders and France, new kinds have of late been procured, possessing a great superiority over those hitherto cultivated in this country. To two distinguished horticulturists, Mr Thomas Andrew Knight, in England, and the Earl of Dunmore, in Scotland, the public is deeply indebted for their peculiar attention to this interesting subject; and such is the success that has already attended their labours, that our countrymen, of the next generation, may enjoy fruits from standards, even in village and cottage gardens, equal in quality to the best that can at present be procured, from the costly walled gardens of our nobility.

II. *Of Orchards.*

It has been a subject of dispute, whether the system of occupying land as an orchard, is advantageous to the individual, and to the public; and whether the soil might not be more usefully employed. In some situations, as in steep banks ([446]), where they are sufficiently sheltered from cutting winds, there can be no doubt, as to the superior pecuniary profit derivable from orchard trees, compared with any other species of produce, more especially to a small farmer, who attends personally to the whole business, and whose wife and children are his assistants ([447]). In various cases also, the produce of an orchard, in favourable seasons, will pay the rent of the industrious cottager ([448]). But whether it is a profitable appendage to a large farm, and advantageous on an average of years, either to the landlord or the tenant, is a different question ([449]). It is objected to the formation of an orchard, that the returns, for the first twenty years, will be small, and that it will be thirty years before the landlord can put any additional rent on his land, on account of his plantation. But this depends upon the management. With due care, the land may be cultivated, for several years, by the spade, with advantage to the plants, and benefit to the proprietor; as the loosening of the earth, and manuring it well, are advantageous to their growth; and when the plants have got to a size to protect themselves from pigs and sheep, the ground may be laid down, in good heart, and become profitable pasture.

The profit of a tenant from an apple orchard, may arise, from selling the cider, either as soon as it is made;—or after keeping it for some time;—or disposing of the fruit;—or using the cider in his own family, in lieu of beer.

In a good year, an acre will produce 800 gallons of cider, which, at 4d. per gallon from the mill, make L.13 : 6 : 8, subject to the following deductions: 20s. for tithes, 40s. for making, and 10s. for gathering; total, L.3, 10s.; balance of profit

L.9 : 16 : 8. But it is seldom that such a crop happens above once in three or four years. At 400 gallons, which is considered to be a fair average, the return would be L.6 : 13 : 4 per acre, subject proportionably to less deductions.

If the farmer however, has capital sufficient to retain the produce of his orchard, and suitable accommodation for keeping it, until a proper opportunity for a sale occurs, should a bad year take place, the price will be advanced to 8d. or 1s. per gallon, and a greater profit, than in the cases above stated, may be obtained. Few farmers, however, have such cellars to keep it in, and all those who have not, must either sell it, or drink it soon after it is made.

But where farmers reside near a canal or navigable river, the most certain profit arises, by cultivating chiefly the better sorts of apples, and selling the fruit for table use, (the finer kinds for desserts, and the coarser sorts for baking and stewing,) instead of converting it into cider. For the same quantity of fruit, (eleven seams of nine pecks each), which would fetch L.8, 16s. unground, would only bring, in cider, L.3, 15s. ([450]).

It is objected to orchards on large farms, that they are apt to interfere with the more important concerns of husbandry, and to abstract that manure, which ought to be applied to the arable land. The cider system has likewise a tendency to introduce a dissoluteness of manners; nor is cider so wholesome or strengthening as malt liquors ([451]).

But it is contended, that lands in pasture, worth only from 12s. to 30s. per acre, would probably be worth L.3 per annum as an orchard;—that Great Britain contains many thousand acres, capable of that species of improvement, at a small expense, and within a short period of time ([452]);—and that by increasing the better sorts of fruit, and pursuing a proper system, fruit grounds and orchards might be rendered a source of riches to those districts, where they can be successfully cultivated, and, at the same time, would prove a source of benefit to the nation at large ([453]). Many instances might be adduced, where small farmers have been enabled to pay their rents, from the produce of their orchard harvest, where care had been taken, in selecting the most useful sorts of fruit-trees, and properly managing them.

It is the more necessary to attend to orchards, as in the opinion of one of the ablest naturalists this country has produced, there is no reason to suppose, unless a great change in the heat of our climate should take place, that vineyards will succeed in England; or that the grape will ever, in such a climate, afford an article, equal in merit, to the produce of the apple or the pear, when the liquors they afford shall reach their greatest state of perfection ([454]).

The points next to be considered, are, 1. The kinds of fruit-trees raised in orchards; 2. The distance at which they are planted; 3. The rent given; 4. The produce; 5. The under-crops; 6. The stock that are kept in them; and, 7. Some particulars regarding the mode of management.

1. *Sorts of Trees.*—For general orchards, in this country, the apple and the pear must be the prevailing trees. Of both there are numerous sorts, of various excellence. Apples that keep long, and are of good appearance, most readily find a market. Among these may be mentioned, the Ribston pippin, the nonpareil, the Norfolk beaufin, the nonsuch, strawberry-apple, paradise pippin, Yorkshire greening, fulwood, red-sweet, Gogar pippin, Eve apple, Irish crofton, Blenheim pippin, and the Downton pippin, with various pearmains, russets, courtpendus, &c. For cider orchards the following are some of the best: the red-streak, cat's-head, coccagee styre, Hagloe crab, gennet-moyle, royal wilding and white-sour. Early pears are in demand near all large towns, and pay well as common dessert fruit; such are the Crawford or Lammas, Carnock or Drummond, jargonelle or cuisse madame, green chisel, green Yair, the premature or citron des Carmes, golden knap, muirfowl egg, swan egg, seckle, &c. For perry orchards, the greatest bearers, and most juicy, though austere sorts, are to be preferred.

Besides the pear and the apple, several other fruit-trees are raised in orchards. Of these, *cherries* are, in some districts, as in Kent and Hertfordshire, the most abundant. They begin to bear about ten years after they are planted; and on an average, they will produce annually, about six dozen of pounds, from the tenth till they reach their twentieth year. A full grown tree will produce 50 dozen of pounds in a good year. The price varies from 10d. to 3s. per dozen of pounds. At 2s. per dozen of pounds, a tree would yield L.5 per annum. The gathering gives considerable employment to the poor ([455]). Some orchards in Kent, have *Spanish chestnuts* planted in them. The produce is extremely uncertain, though very profitable in good seasons ([456]). *Walnut trees* are likewise to be met with, and are calculated to yield about L.5, 5s. per tree per annum ([457]). *Filberts*, under proper management, are a profitable crop in an orchard, but they are supposed to be great impoverishers of the ground ([458]). *Plums* are sometimes raised with advantage near good markets ([459]). Where apples thrive, as in the counties of Somerset, Devon, and Cornwall, other fruits are too apt to be neglected.

2. *Distance and Mode of Planting.*—In Devonshire, orchard trees are small, and are seldom found standing at a greater distance than sixteen feet from each other. In some places their branches are so interlocked, intermixed with dead wood, and covered with moss, that the fruit is hardly visible ([460]). To remedy this objectionable practice, it is recommended, that the trees should be planted at sixty feet every way from each other, by which means they become productive, and the pastures suffer but little injury. The desire of having a great deal of fruit, on little ground, is the cause of planting too close; but by this method, the intended object is defeated ([461]).

In the grass grounds of Gloucestershire, and arable fields of Herefordshire, twenty yards is the usual distance; sometimes even twenty-five; a chain, or twenty-two yards, is a proper medium ([462]). Young trees ought not to be planted in the same spot whence the old ones were removed. The roots of the old tree are the habitations of multitudes of worms and grubs, and they should be carefully removed, otherwise they will do serious damage to the young trees.

3. *Rent.*—The orchards in Somersetshire let from L.3 to L.6 per acre ([463]). In Hertfordshire the rent is about L.4 per acre. They are generally under grass, and fed off with sheep ([464]). At Coldstream, in Scotland, an orchard is let for 21 years, at L.6 per acre for the first seven, and L.7 for the remaining fourteen years ([465]). In the west of Scotland, the rent is still higher, varying from L.6 to L.12, and sometimes it is as high as L.16 per statute acre; but the produce is sold, *as fruit*, to an extensive manufacturing district, and not converted into cider ([466]).

4. *Produce.*—In orchards, a full crop once in five years, and an average crop once in three years, are as much as can fairly be expected ([467]). This is partly owing to the uncertainty of the weather, at the season of flowering, and partly to the trees becoming exhausted, and requiring repose.

In Devonshire, the average produce of an orchard is reckoned at $3\frac{2}{5}$ of a hogshead per acre per annum. The average price at the press is 50s. consequently the average produce of an acre is about L.8, 10s. per annum ([468]).

In Herefordshire, from 24 to 30 bushels of apples will make a hogshead of cider, or 110 gallons. Twenty hogsheads of cider have been made from an acre. This is only at the rate of 40 trees per acre, and half a hogshead per tree. The average price of cider is from 25s. to two guineas per hogshead.

The entire produce of four counties, (Gloucestershire, Monmouth, Hereford, and Worcester), may be calculated at 30,000 hogsheads, raised at the rate of 20 hogsheads per acre, on 1500 acres (469). At L.2 per hogshead, this would amount to L.60,000, or L.40 per acre. At 30s. per hogshead the return would be L.30 per acre.

It has been disputed, whether pears or apples ought to be preferred in orchards. The pear in general produces an inferior liquor, but possesses many advantages over the apple, for general culture. It flourishes in a greater variety of soils; —it is more ornamental;—its fruit is less liable to be stolen, (those sorts which are proper for perry, being unfit to be eaten, or applied to common culinary purposes);—and it is more productive, trees in general, when nearly full grown, producing annually 20 gallons of liquor; and as each acre is capable of containing 30 pear trees of the usual dimensions, the average produce may be stated at 600 gallons per acre. On the other hand, though an acre planted with apple trees, will produce but one-third as much liquor, yet the apple begins to bear at an earlier age, and cider will ever be generally preferred to the juice of the pear (470).

That sort called *winter apples*, are superior to cherries for profit, for they will keep till they are wanted, either for sale or use; but cherries will burst or drop, if they are not gathered when ripe, and there is not always a demand for them (471). Cherries are likewise apt to be destroyed by birds.

It is said, that the importance of apples, *as food*, has not hitherto been sufficiently estimated. The labourers in Cornwall, consider them to be nearly as nourishing as bread, and more so than potatoes. In the year 1801, when corn was so scarce and dear, apples, instead of being converted into cider, were sold to the poor; and the labourers asserted, that they could stand their work, on baked apples without meat, whereas a potatoe diet required either meat or fish (472).

5. *Under Crops.*—These are of various sorts, depending on the age of the orchard;—on the extent of distance between the trees;—on the situation of the orchard;—on the quality of the soil, and other less important circumstances; but they may be classed under the following heads; arable crops;— garden crops;—grass;—and miscellaneous articles.

In young orchards, the ground, if flat and arable, is not unfrequently put under a rotation of corn and green crops; as, 1. Oats; 2. Potatoes, with dung; 3. Oats, sown down with clover and rye-grass; 4. Hay; and 5. Hay (473). But it is much more advisable, to cultivate the land with the spade than the plough. The harness and the implement do so much injury to the trees, that they cannot be depended on for the production of fruit. Their roots, also their drip, and shade, are destructive, not only to corn, but to clover, and to turnips; impeding the free circulation of air, and obstructing the teams when ploughing. While the trees are young, however, the land cannot be too much stirred ([474]).

In Gloucestershire, orchards are kept in grass, in which state, under ordinary management, the progress of the trees is comparatively slow, for want of the earth being stirred about their roots, while the trees are injured (more especially low-headed drooping trees), by the grazing stock. Cattle also, if admitted at the season when the fruit is growing, destroy all that is within their reach, and often suffer from the fruit lodging in their throats. Notwithstanding these disadvantages, when the trees become of such a size, as to be injurious to the arable crops, the ground ought to be converted into a state of grass ([475]). The herbage produced in an orchard also, comes very early in the spring, when it is peculiarly valuable to the farmer. Under judicious management, it is never suffered to grow long or coarse; and an orchard in this condition, will be found to support a very considerable quantity of stock ([476]).

The fruit-gardeners near London, have, what they call an *upper* and *under* crop, growing on the same ground at one time, The *upper* crop includes apples, pears, cherries, &c. The *under* crop consists of raspberries, gooseberries, currants, strawberries, and those shrubs and herbs which are known to sustain the shade and drip from the trees above them, with the least injury ([477]). Near Glasgow, small fruits are in great demand, and are frequently grown in orchards. There are instances of L.100 being got for an acre of gooseberries, near a manufacturing town ([478]).

In young orchards, the spaces between the trees, are in some cases occupied with hops ([479]), and in others, with filberts. In grown orchards, the filbert is frequently seen, though this is far from being generally the case. Some old orchards are in permanent sward; others bear arable or garden crops: some are in sainfoin; others in lucern ([480]). Sometimes the interstices are used as nursery ground; but this seems a bad plan, as it exhausts the land and prevents its being properly stirred.

In Devonshire, the trees of orchards are kept so low, that the use of the land is in a great measure lost. Horses are sometimes allowed to run through them; and calves in early spring; but grown cattle and sheep are at all times prohibited; likewise swine, when the fruit is on the trees ([481]).

6. *Stock.*—Cows are frequently grazed in orchards when in

pasture. To prevent the animals from eating the fruit, when the trees are loaded with apples, their heads are sometimes secured to the fore feet by means of halters (482).

The same plan, to prevent cows from raising their heads high enough to browse the branches of the trees, is adopted in the cherry orchards of Essex (483).

Sheep are injurious to orchards, by breaking the trees, which may easily be obviated, by a wash of lime and night-soil, applied to the height of three or four feet on the stem of each tree, previous to the sheep being admitted. This precaution is particularly necessary for the first ten years after an orchard has been planted.

It is an useful practice, to turn hogs into orchards, and give them there beans or other food. The turning up the earth, in search of roots, is thought to be of use to the trees, and tends to the destruction of weeds, grubs, and insects (484). It is necessary however, to use precautions, when any species of stock is admitted into an orchard, as swine are fond of fruit; sheep eat it with avidity; and deer are still more partial to it (485).

The chief orchards in Scotland, being either upon banks, so steep as to be inaccessible to cattle, or in clayey soils, which might be injured by poaching, are seldom pastured. Yet orchards thus kept, must have a disgusting appearance, since weeds, instead of grass, are likely to abound. Grazing with sheep or cattle, or, if necessary, using some manure to the trees, would seem to be preferable to the admission of swine un-ringed. The trees in general, are only trained as half-standards. The grass is therefore cut with the scythe, and given to cows and horses, though there are not wanting prejudices against this practice (486). It is not approved of in England, where mowing the grass of orchards, is thought to exhaust the ground so much as to be destructive to the trees in it. Some orchards, which were very productive when fed, have produced nothing after a few years mowing (487). Perhaps this may, in part at least, have been owing to other causes; and, if tried, some kind of manure or compost, might doubtless be found, to supply the place of the dung of the cattle.

7. *Management.*—The forming an orchard is a work of time. Where shelter is necessary, a belt of planting, 50 feet wide, and 30 yards from the fruit-trees, should be prepared. It is advisable, to plant only 25 feet of the belt first, and the remaining 25, about 12 or 15 years afterwards: a close screen is thus secured, for a much longer period, than if all the trees had been planted at once (488).

No excellence of culture or management, can make up for the want of a dry and sound bottom. Hence the necessity of draining thoroughly, whenever moisture is suspected. When young trees are planted, the earth should be dug sufficiently deep, to facilitate the passage of the water, that it may not injure the roots. The surface should likewise be trenched with a spade, the year before planting, to the depth of at least two feet, and as much *rotten manure*, ashes, lime-shells, or marly sand, used, as can be spared, or conveniently got, increasing the quantity as the soil is poor.

Some have imagined, that when the roots of fruit-trees reach the cold and unfertile stratum or subsoil, they become stunted, and unproductive, and soon perish. To prevent this, it has been recommended, to dig pits to the depth of eight feet, and fill them up with brick-bats, cinders, &c. and to lay over these pits, one or more courses of flags, to prevent the roots of the trees, from reaching the injurious subsoil; and to cause the trees to send their roots in a horizontal direction. Others content themselves with merely placing flags, between the soil and subsoil, without digging any pit; and some have collected as much soil, as could be obtained, and raised it up into a hillock, three or four feet in the centre, in hopes, that the trees would confine their roots to that earth, and avoid the subsoil. These are all meant as improvements; and it is said, that some of these precautions were taken by the Monks, when they planted orchards in ancient times. But others, who have paid much attention to such matters, are of opinion, that these preventives can do no good. A pit of eight feet, or of any other depth, sunk in a hard clayey subsoil, would stand brimful of water, even when filled with the materials that have been mentioned; so that the tree would not have a rich soil to stretch its roots into, but merely a deep pit full of brick-bats, with cinders, and with water. Flags placed over a pit so filled, or even on the solid subsoil, could do no good, as the trees would send their roots over them, and sink them into the forbidden subsoil under the stone. Neither can the collection of soil to the height mentioned, do much good; for that part of it which is excluded from the sun and weather, will, in a short time, become as inert and sterile, as the subsoil under it; and if it is no more than three or four feet in depth, the roots of the trees, will soon advance through it, and go into the subsoil under the hillocks.

The same opinions were advanced, a good many years ago, respecting thorns in fences, being killed by their roots reaching the sterile subsoil. Both, however, proceed from other causes, and are refuted by most satisfactory evidence of facts.

Nearly all the orchards on the banks of the Clyde in Scotland, are planted upon bare, hard clayey land, where the soil is very thin, and the subsoil an adhesive *till*, or ferruginous clay, of the very worst quality, incumbent on sand-stone, of the coal formation; yet, though the precaution of laying flags under the roots of the fruit-trees, was talked of, and in some few instances acted upon, fifty years ago, it has never come into general practice. Not a tree in some hundreds has ever been placed on flags; no advantage was found to be derived from the practice, and it is now abandoned. The trees that were planted without flags, have been found to grow as well, and to be as productive of fruit, as those that had these appendages.

By some, mixtures of lime, night-soil and soot, have been made up, to be put upon the bark of the young trees, as a protection from the attacks of hares and rabbits. But as this has an offensive smell, and stains every thing that touches the trees, it is much better, to twist ropes of straw round them, or to fix the end of a few twigs of broom into the ground, at the root of each tree, and to tie them to the tree by a rope.

It is a maxim in the management of the orchards in Scotland, (which is peculiarly necessary in that country, on account of the variableness of the climate), to plant a considerable number of different sorts, both of the early and the late kinds: for at one time, the blossom of a particular variety, may be destroyed by frost or a moist north-east wind, while the blossom of another kind, either earlier or later, may escape:

Where the Devonshire plan is adopted, of covering the ground with trees, they should be planted in *quincunx*, or in the centre of circles, in contact with each other, according to the following plan (489):

To understand this properly, the trees should be planted at 15 yards distance from each other in the rows, and 13 between the rows, and the trees of the second row should be in the middle between the trees in the first and third rows. If a larger distance is preferred, the proportion of 15 in the row, to 13 between the row, should be preserved.

In all the orchard districts, there are the greatest complaints of the decay of trees, and the state of unproductiveness into which they have fallen ([490]). Where that takes place, the plan of peeling the outer bark of these decayed trees, (as already explained in the Section of Gardens), and either trusting to their natural growth, or engrafting on them new varieties, ought to be tried.

An easy remedy for the white blight, or American bug, has been discovered. It is only necessary to clean the diseased parts, and to apply to them common fish oil, such as is used in coarse out-door work, with a brush, by which means the nuisance may be got rid of without injury to the plants ([491]).

It is a rule, that standard trees in orchards, should be trained, pruned, and cleaned, with as much care as wall-trees, in order to ensure their productiveness, at least while they are young. When the stems are well swelled, the head well formed, and there are three or four flourishing main branches, it is only necessary to take off the annual shoots which form on the limbs, or any foul or ill-directed shoot accidentally produced.

It cannot also be too strongly inculcated, that to permit young plants to bear fruit *for some years*, is eventually productive of essential injury to their future fruitfulness and duration ([492]).

PART IV.

WOODS AND PLANTATIONS.

I. *Of Woods.*

The occupation of land, either with natural wood, or planted timber, is attended with numerous advantages. Trees contribute to the ornament and the shelter of a country ([493]); and the importance of timber, as applicable to naval uses,—to the building and repair of houses,—to the construction of machinery,—to husbandry,—to mines,—to various essential manufactures,—to utensils,—to fuel,—and to several miscellaneous objects, as the feeding of stock,—the construction of bridges,—the production of pitch and tar, &c. has been so frequently laid before the public, that these particulars need not here be dwelt upon (494).

Notwithstanding these advantages, and though woods are considered by many, as amongst the most profitable lands in their possession (495), yet others contend, that whether in respect to the landlord or his tenant, to individuals or the public, woods are considerably inferior to corn and herbage. It is ingeniously urged, that as the kingdom advances in cultivation, woods and forests are made to disappear;—that when they vanish before population and corn, it may be considered as a most convincing proof of national prosperity;—and that to complain of scarcity of wood, is preferring a produce that yields only 20s. to another that affords per annum at least from 80s. to 100s. and upwards, per acre (496).

In discussing this subject, it is proper to consider, 1. What soils are peculiarly calculated for the production of timber; 2. What soils may be applied to the growth either of timber, or of grain and herbage; and, 3. Whether those soils, which are peculiarly calculated for the growth of corn, or of artificial grasses, may not have some timber intermixed with them, without detriment to the corn or herbage.

1. There can be little doubt, that where the soil is not worth more than two or three shillings per acre, it can hardly be more advantageously employed than in the growth of wood, suited to its nature, situation, and climate; and there are very few of the most exposed and barren wastes, where, by proper care and attention, timber of one species or another may not be produced (497). By planting also, such wastes are often improved; the falling and putrefaction of the leaves, tending to thicken the soil, and to render it by degrees richer, and more capable, either of promoting the growth of timber, or of being converted into arable land (498).

Where the land is steep and precipitous, and more especially covered with stones, there are no means, by which so much profit can be derived from the soil, as from woods. This is particularly experienced in some districts in the counties of Perth, Stirling, Dumbarton, and Argyle, where the annual produce of a statute acre of copse wood, may be stated at L.1, (L.1, 5s. per Scotch acre); a return which far exceeds, what could be drawn from the soil on which it grows, in any other way (499). *In a favourable situa-*

tion, (as in the case of Somersetshire, to be afterwards mentioned), the profit is still more considerable.

2. In regard to soils calculated either for wood or cultivation, it is said that the proprietors, in many instances, derive more profit from the sale of wood, than could be obtained from the rent of land, if cultivated. In some parts of England, where black sallow abounds, an acre, at twelve years' growth, is worth L.15, and pays better than the adjoining arable fields ([500]). Where the Spanish chestnut is cultivated, instead of the black sallow, the profit is still more considerable. In Kent, the late Lord Barham cut down a plantation of chestnut, for hop-poles, at nine years' growth, and drew from it L.104 per acre ([501]). In eleven years, a plantation of larch, on a very poor light loam, not worth more than from 6s. to 7s. per acre for cultivation, produced, for hop-poles, at the rate of L.91 per acre ([502]), or L.6, 8s. per annum, subject to the usual deductions.

Much, however, depends on *the nature of the soil, and of the subsoil* ([503]). *The situation*, also, merits consideration, before we can properly decide whether the growing of wood is to be preferred to cultivation.

Lord Bagot's woods in Staffordshire, are upon a gravelly loam, incumbent on a clay or marl bottom. It is a soil of so cold a quality, that it would not be worth a rent of 10s. per acre, if cultivated; and it pays much better when covered with timber and underwood ([504]).

In the county of Somerset, the ancient forest of Selwood contained about 20,000 acres, of which 18,000 have been converted into arable, pasture, or meadow land; the remainder still continues in a state of coppice. Much of the land that has been brought into cultivation, does not rent at more than from 10s. to 12s. per acre; whereas some of those coppices which lie towards the northern end of Selwood, though, from the soil and exposure, they cannot be cut oftener than in eighteen or twenty years, yet produce an annual value in timber and underwood, of from 15s. to 30s. per acre ([505]).

In an extensive wood in the same county, but disafforested in the reign of Charles I., the profit of woodland, under any tolerable degree of management, may, it is said, be fairly taken at nearly double the value of the adjoining land, whether occupied by crops or pasture ([506]).

The coldness and sourness of some descriptions of land, when brought from woodland into culture, tend much to depreciate their value, however they may be employed. In an arable state, such land will not, in the first instance, produce grain kindly for many years. In a favourable season, it may yield a tolerable crop of oats, but it is totally unfit for barley, and unless it be heavily manured, is too poor for beans. Wheat is late of ripening, and requires more dung than can well be afforded. If in grass, from the lateness of its growth, the value of the land is much reduced, and it is ill suited to the dairy, though that is the mode of application to which it is best adapted([507]). But as a general rule, it may be laid down, that all land capable of bringing the oak to maturity, and not too steep or too rugged to be cultivated, should be applied to the purposes of agriculture ([508]). After the most accurate investigation, it appears, that where the soil is of good quality, more profit is derived from cultivation, than from retaining land in wood ([509]).

In most cases, however, the profit depends upon situation.

In the county of Wilts, although the general use of pit-coal has considerably diminished the consumption of wood and charcoal, for domestic purposes, the demand for underwood is still so very great, that woodland will not only yield a sufficient rent, *but, if in good situations,* and well managed, will produce at least half another rent, by the timber which may be raised, without any material injury to the underwood ([510]).

In Somersetshire, the growth of coppice or natural wood, if secured from the south-west breezes, is so rapid, that the profit is more certain than from any other produce; and greater than any individual would believe, who has not had experience of it. From rapidity of growth, it is more profitable to cut down the coppice every twelve years, than to let it remain longer. An acre produces L.16 every twelve years, after the expenses of cutting, carriage, &c. have been deducted. This is nearly at the rate of 28s. per annum, besides the accumulating value of the timber trees. This great profit, however, is principally owing to these woods being near coal-pits, where ash poles fetch a high price. The 28s. received in this case, at the distance of twelve years, is equal to 20s. per annum, liable to taxes, and some other deductions. But it would be difficult to let such land for cultivation, at a rent of even 10s. per annum ([511]).

It were endless to go through the various other instances of profit derivable from woodland. It may be sufficient to add the following instances: 1. The woods belonging to Sir Joseph Banks, at Revesby, in Lincolnshire, pay at the rate of L. 45, 7s. cut once in twenty-three years, which is L. 1, 19s. 5d. per acre per annum; but if let at 17s. per acre per annum, payable half-yearly, and put out on simple interest, the amount would be the same ([512]). The land, however, is of so indifferent a quality, that it would not produce, if cultivated, more than from 10s. to 12s. per acre ([513]). 2. The underwood of Col. Beaumont's woodlands in Yorkshire, is cut down every twenty-one years, and is worth, upon an average, L.55 per acre, besides L.18 worth of wood left to stand for a future fall. These woodlands in general, if they were cleared of all timber, underwood, &c. and put into cultivation, which would be at an enormous expense, would on an average be worth only 5s. per acre ([514]).

But, on the other hand, when land is cultivated, it yields a return every year; whereas in wood, the profit is only occasional, and in the case of timber, extremely distant; and various comparative estimates have been made, to prove the superiority of cultivation, particularly on good land.

In Derbyshire, a fall of wood of twenty-five years' growth varies from L.40 to L.100 per acre, clear of all expenses of fencing, draining, and superintendence. About L.65 is nearly the average ([515]). Forty pounds' worth of timber, however, is always lying dead, in the trees remaining in the ground, deducting the interest of which, the rent of the woodland is only 12s. 8½d. per acre per annum. Compound interest on the L.40, at 3½ per cent. would reduce the value of the next cutting to 7s. 4d. per acre, and if calculated at four per cent. compound interest, the dead stock would be L.66 : 12 : 8, exceeding the cutable produce by 15s. 2d. ([516]).

In the Weald of Sussex, the common system of husbandry is, a fallow, two crops of corn, and one of clover, the produce of which, during that course, is stated at L.15, 2s. or, for the four years, L.3 : 15 : 6 per annum ([517]).

The highest produce, in the most favourable soils for wood in Sussex, is L.1 : 0 : 5; consequently the gross produce by corn, is L.2 : 15 : 1 per annum, more than by wood, though obtained at greater expense ([518]).

Besides, were it admitted as a general maxim, that the strength of a country depends more upon the number of men, than the number of trees, and that those lands, which can be employed in the immediate production of animal or vegetable food, should not be occupied in the tedious production of future timber ([519]); yet still, there are exceptions to that rule, which well merit consideration.

In many districts, were they divested of wood, fuel could not be obtained; manufactures must cease; mines must be abandoned; several branches of husbandry, and the culture of hops in particular, could not be carried on: And when it is said, "Let timber then be imported," it is not considered, that the expense of conveying so bulky an article, more especially to inland districts, or places where trade is but little known, would be intolerable. Indeed, those only who live in a country where wood is difficult to be had, can form any idea of the situation of the people, where that essential article is not to be met with ([519]).

In the neighbourhood of great towns, and of the metropolis in particular, woods are not to be encouraged, being nurseries for thieves; and because the ground, in such situations, can evidently be more profitably employed.

3. As to soils, peculiarly adapted for the culture of corn, even there, by a judicious planting round the borders of arable fields, or of corners, liable otherwise to lie waste, much timber may be raised, that would be equally adapted to house and ship building. The profit of plantations, on the borders of fields, is very great in Flanders ([520]), and, though the vicinity of wood is not favourable to the production of corn, yet the shelter which it affords, improves the climate and prevents evaporation, and the moisture which the wood occasions, greatly promotes the growth of herbage.

Such was the information collected regarding the value of timber, when the last edition of this work was published, in 1817, and it contains some important particulars, which it was thought right to preserve in this impression. Since that period however, great alterations have taken place in the value of every species of agricultural production. The prices of timber, poles, and firewood in particular, have of late years been greatly reduced. Hence the profits from woods and woodlands, even under the best management, are now proportionally small, and in many cases indeed, where subject to tithe and poor-rates, *they are absolutely losing concerns.* This depression has arisen from various causes, but more especially from the low prices of foreign timber; from the repeal of the coal tax, which renders timber less necessary for the purposes of fuel; and from iron being frequently substituted for timber, in the construction of buildings, agricultural implements, &c. &c.

The remaining points to be considered in this section are, 1. The different sorts of natural wood, and their management; and, 2. The various kinds of plantations, their mode of management, expense attending them, &c.

I. *Of Natural Woodlands.*

Natural woodlands, are divided into four sorts: *coppices*, containing underwood merely;—*mixed woods*, consisting both of timber and of underwood;—*groves*, which contain nothing but trees;—and *forests*, or extensive tracts of country, covered with large timber and bushes.

1. *Coppices.*

It is not usual to have woodlands entirely copse; as it is considered more advantageous, to have wood of various sizes, so as to suit all kinds of customers. In this way, it is disposed of with more advantage to the owner, and more convenience to the neighbourhood. The small wood is used for laths, baskets, hedge-stakes, puncheons for coal-pits, &c. those of a larger size, for husbandry implements of every description; while the largest timber is employed in the construction of houses, and the building of ships ([522]). At the same time, in some districts in England, no standards, or saplings, are reserved. It is laid down as a maxim, "that small gains, and *quick returns*, make the dealer rich; but that long credit ruins him." It is a rule, therefore, with that view, to cut down *the whole coppice* as soon as it is saleable. The loss of the interest of the money, and the damage which the underwood receives from the drop of the standards, are favourable to this system ([523]).

The principal points to be attended to, in the management of coppices, are, 1. Fencing; 2. Draining; 3. Shelter; 4. The age of cutting down; 5. The season of the year for performing that operation; and, 6. The application or uses.

1. *Fencing.*—The inclosing of coppices, is the most essential of all particulars connected with their management. A landlord had better admit cattle into his wheat field, than among his underwood. In the one case, they only injure the crop of one year, whereas in the other, by biting and mangling one year's shoot, mischief is done to the amount of at least three years' growth. By the bite of cattle, there is a peculiar injury done to the growth of wood, the irregularity of the incision bruising and lacerating the plant. At five, or even six years of age, the young shoots are neither high enough to be out of the reach of cattle, which eat them greedily, nor strong enough to resist their weight, when they

press upon them, in order to reach the succulent buds on the top. When oak woods are eaten, or cropped by cattle, they never thrive, until they are cut over at the ground ; and when the injury has taken place, the sooner this is done the better [524].

Great mischief has been done to many thriving woods in England, from their being subject to common rights of pasturage for cattle, and in some instances, for deer ; in consequence of an idea, that cattle or deer do little injury to woods, after the latter are seven years old. But it may be remarked, that if the owners of such woods saw this injury in its proper light, they would not hesitate to make ample compensation to the commoners, to induce them to abandon such rights of pasture [525].

While in a state of commonage, the young plants that spring up spontaneously, are so much exposed to injury that few of them come to perfection [526].

Mr Davis calls the stools that produce coppice wood, *under-ground pollard trees*, which have their youth, their perfection and their decay. During the first and last stages of growth, they are particularly susceptible of injury, and if the wood is constantly cropped, it will ultimately perish.

Sheep are likewise considered to be destructive, as they frequently injure the trees by rubbing against them.

Horses are not apt to do so much mischief as cattle, unless they are pressed with hunger ; but hogs do the least injury, and where acorns abound, this species of stock are the most profitable. At the Conquest, woods were valued, not by their quantity of timber, but by the number of swine their acorns would maintain [527].

2. *Drainage.*—Oak timber always flourishes best in woods moderately moist, rather than in those that are wet. Where woods therefore are wet, they should be drained, by open cuts, because the roots would soon disturb and stop up covered drains. This plan is now, in some cases practised, and is found to be as profitable in respect of woods, as in arable land. Where that plan is not adopted, the willow and the sallow ought to be multiplied. Attention to draining, would prove highly beneficial in the wet heavy woodland counties, and greatly promote the growth and durability of oak and other valuable timber [528].

3. *Shelter.*—The great object, in the management of coppice is, to accelerate the growth. It makes an immense difference in point of profit, when a coppice can be cut in twelve, instead of twenty-four or thirty years. The slowness of the

growth, is either owing to injury done by cattle, or to coldness of the soil or climate, (which may be improved by draining), or is occasioned by exposure to the violent south-west winds. This however, may, to a certain degree, be obviated, by skirting the wood, according to the nature of the soil, with Scotch fir, Spruce fir ([529]), and other hardy plants; and a moderate quantity of timber, may likewise have the effect of screening the underwood from the severity of the blast.

4. *Period of cutting.*—Customs vary, as to the number of years' growth, at which coppices ought to be cut, from 9 to 27 and 30 years. It must depend on the rapidity of their growth, and the uses to which they are to be applied. In favoured situations, a growth of twelve years is considered to be sufficient; but in many instances, underwood cannot, by the best management, be made worth more than L.8 per acre, at 16 years' growth. Twelve small oaks, however, per acre, worth 20s. each, may be cut regularly at the same time, which renders the total produce L.20 per acre every 16 years ([530]). The great wood proprietors in Scotland, generally cut their oak coppices at periods of from 20 to 24 years, and sometimes even of 30 years. The principal object in that country is the bark, which is considered to arrive at its greatest perfection, at the age of between 20 and 30 years. *Under* that age, at least in the climate of Scotland, its virtues are weak; *above it* the bark becomes coarse, and loses its sap ([531]).

In Norfolk, Mr Blaikie informs me, that the underwood is cut at six, seven or eight years' growth. It is principally worked up into wattled hurdles, used for sheep-folds. The cutting is commenced as soon as the leaf begins to drop in autumn.

Underwoods, when felled, should be cut *upwards* and *close from the ground*, leaving the stubs quite smooth. When so cut, the succeeding shoots are not only cleaner grown, but they are stronger and taller at six years' growth, than they are at eight years when *cut down*, and the stubs left sticking out of the ground with their tops *splintered*, as they always must be when cut *downwards*. This remark on *cutting up*, and *cutting down*, is applicable to all trees and bushes; whether cut high or low, and whether cut by knife, bill-hook, or hatchet.

5. *Season for cutting.*—There are many opinions, respecting the proper season of the year, for cutting underwood; but there is one rule, which, for the advantage of the seller, should be steadily adhered to, namely, that the older

the wood is, the later in the spring it should be cut. When old wood is cut early in the winter, and a severe season follows, the damage done to the old stock, and to the standards, is very great. On the other hand, it is supposed to be for the interest of the buyer, that all wood should be cut in the most stagnant state of sap, as being, in that case, more durable; and in all cases where bending is required, such as hurdles, hoops, and even dead hedges, the wood cannot be cut too early in the winter, for if cut when the sap is rising, it becomes brittle, and unfit for those purposes ([529]). With regard to seasoning timber, there is a difference of opinion, at what period timber should be felled. But as the value of bark is considerable, the spring, on the whole, is the most profitable to the owner.

6. *Application and Uses* ([530]).—It is well known, that in an oak coppice, the principal profit is derived from the bark, and that sometimes, at 16 years' growth, when the wood fetches only L.6 for charcoal, the bark will produce L.15 ([531]). The wood of coppices, may likewise be converted to various minute purposes. Charcoal was formerly a great means of consumption ([532]), but since charred pit-coal has been employed in the manufacture of iron, that is no longer so great an object, and the charcoal of wood has considerably gone into disuse. In some districts, as in Sussex, the brushwood is employed with great advantage, in the burning of lime. Fortunately also, a new mode of using the small wood of oak, &c. has been discovered, namely, that of extracting from it, a liquid pyrolignous acid, in considerable quantities, for the use of the manufacturers of dyeing and printing colours, and for various other purposes. The extreme twigs and buds of the oak, may likewise be used in tanning ([533]).

2. *Mixed Woods.*

The management of woods, where there are both large trees and underwood, though not without its difficulties, does not require the same degree of skill, or unceasing labour and attention, as the cultivation of arable land, or the management of live stock. It is principally necessary, that the woods should be properly fenced;—that they should not be damaged by the inroads of cattle or other stock;—that drainage, and other practical modes of improvement, should not be neglected;—that the wood should be divided into regular falls, or portions, so as to furnish an annual income, with as much certainty as arable land; and that when sold, every pains be taken to procure their full value. By these means, and the reservation of an adequate share of large timber, the proprietor will generally have a safe, and perhaps an improving treasure at his command ([534]).

In Scotland, it is the general practice of wood holders, to *reserve*, at every cutting, a certain number of trees, of the most beautiful and promising appearance, to become timber at a future period. At the first cutting, about the age of 24 or 30 years, between 3 and 400 trees per acre, are generally reserved. At the second cutting, when they are 48 years standing, the number is considerably diminished. They are still farther reduced when they are 72 years old, and the process is sometimes extended to a longer period, when timber is obtained of a considerable size, and applicable to various domestic and naval purposes. The abstraction of nourishment, and the droppings of a large tree, will, in a considerable degree, affect the young shoots in the neighbourhood; but the injury thus sustained, must perhaps be borne, because, in a public point of view, the possession of large timber is an object of national importance ([535]).

The trees principally grown in woods are the oak, the beech, and the birch.

1. Some of the best English oak is naturally produced in the Weald of Sussex, and underwood is there considered to be its best screen or nursery, contributing greatly to the growth of the trees mixed with it, by its shelter and protection. The standards in Sussex produce about 5s. per acre per annum; and the underwood, while it grows, at the same rate; which brings both to a par with the arable and grass land in the neighbourhood, as they rent at about 10s. per acre. But the trees, when they increase in size, do mischief to the underwood, and when the timber is left standing for 100 or 120 years, the underwood is effectually destroyed. Lord Sheffield sold 30 acres of wood for L.1400 or L.46, 13s. per acre, which divided by 100, when the oak arrives at perfection, is 9s. per acre per annum, besides the profit of the underwood, while it remained productive ([536]). Some of the best thriving woods on the Petworth estate, yield of gross produce, at the rate of 20s. per acre per annum, and of net profit about 12s. ([537]). The profit from timber, however, in other places, was so inconsiderable, that the income produced, was less from woods, than from arable, or pasture lands, of similar quality: and this disproportion existed, though timber has increased, within the last 15 years,

as 11 to 7, and bark, as 15 or more, to 8; and other articles, the produce of such woods, in nearly the same proportion [538].

In the neighbourhood of our naval arsenals, however, the case is now different. Formerly, while the Navy Board availed itself of the monopoly of large timber, which it in a great measure enjoyed, to keep down the price, it became a maxim with timber growers, on account of that debased price, that it answered better, for the sake of the quickness of the return, to cut down an oak, before it reached the value of 40s. or even 20s. [539] than to suffer it to remain, till it acquired a large size. The highest price, 30 or 40 years ago, did not exceed five guineas per load: the same, or even inferior timber, has recently sold for L.15 per load. A good price being of late obtained, there is a much better prospect that oak timber will be permitted to reach a large size; and if a greater difference of price were allowed for timber of the largest dimensions, compared to that of inferior sizes, the growth of large timber would be essentially promoted. Under a proper system, therefore, it can scarcely be doubted, that Great Britain could with ease furnish the utmost quantity of oak timber, which can ever be required for her military and commercial shipping, without any material interference with other branches of land produce [540].

2. In Buckinghamshire, the Chiltern districts of Oxfordshire, in some parts of Hampshire, and generally where the soil is chalky, or incumbent upon limestone, beech is the most abundant wood. In Buckinghamshire, they are *drawn*, or thinned annually, by certain portions, the young trees being left for succession, and the large single stems, at 30 or 40 years' growth, being cut down, sawn into lengths of about four feet, converted into billets for fire wood, and conveyed by the Thames to the London markets. Good beech woods, on this system, will, it is said, pay about 20s. per acre, clear of all expenses [541]. It requires some judgment to thin these woods, so as to prevent the standards from hanging too much over the young seedlings; and in southern aspects, to prevent the injury that may take place, if the soil is too much exposed to the sun [542]. Mr Fane of Oxfordshire, pays great attention to the training of his beech trees, to lead and keep them as erect as possible, that a spreading growth may not drip on and check the young succession [543]. The Bishop of Durham at Mongewell, possesses beech woods, which are managed on the thinning system, at 20 years' growth, and pay about as well as letting

the contiguous arable land ([544]). The beech excels all other trees for producing great quantities of *mast,* which is an article much relished by hogs and deer, and yields much oil, fit for various important purposes ([545]).

The trees allowed to stand to become timber, in the mixed woods at Holkham, are oak, ash, elm, beech, sycamore, lime, sweet chestnut, locust acacia, evergreen oak, and Scotch and silver firs. The underwood is chiefly oak, elm, sweet chestnut, and hasel.

In several districts of England and Scotland, there are extensive tracts of natural birch. They have a beautiful effect upon the scenery, and form a comfortable screen to increase the warmth in such situations; but the value of the timber is much inferior to that of oak, and the bark, though used for tanning leather, is much less powerful than oak bark ([546]). The mode of extracting tar from the birch, particularly from its bark, which is found of such importance in Germany and Russia, has not yet been introduced into this country.

The rules for the profitable management of woods in general, are neither numerous, nor difficult to execute. The proprietor should fix on those sorts of trees, the most likely to be in demand;—he should have them examined at stated periods, that he may know what trees are increasing in value, what stationary, and what decreasing;—he should select such young trees as are best adapted to keep up a regular succession, so as to produce the greatest quantity of timber, on any given quantity of land, consistently with the growth, and comparative value of the underwood;—he should cut down such as are likely to obstruct the growth of the trees intended to be preserved;—and he should accurately ascertain, what period of their growth is the best suited for the markets to which they are to be sent, and the purposes of the consumer ([547]). By attention to these simple rules, property in wood may be rendered much more valuable than otherwise it would be.

3. *Groves.*

If profit is alone to be considered, trees, of every species, ought to be cut down, when the annual increase in value of the tree, by its growth, is less than the annual interest of the money for which it would sell ([548]); and the annual value of the land on which it grows ([549]). But such is the inadequate price of large, and even middle sized timber, that it is still too much for the interest of the owner, to cut down even the finest oak, when it is worth 40s. than to keep it till it is fit for the Navy ([550]). Fortunately, however, for the naval strength of the country, there is nothing more ornamental for the seats of landed proprietors, than groves of thriving trees; and on that account, much timber is preserved, that would otherwise have been cut down.

But trees, at a proper distance from a manor house, are not only ornamental, *but useful;* if too near, they obstruct the free current of the air, and send forth great quantities of moist exhalations, which render it constantly damp. Thick woods, therefore, ought to be avoided, near a house, more especially in a flat country. At a proper distance, however, they are of service, from the shelter they afford against cold winds, and from the shade they yield against the heat of the solar rays.

The value of a grove likewise, is frequently very great. Mr Davies states, in the Report of Wilts, the result of an accurate estimate of one acre of timber, in the grove at Longleat, (the seat of the Marquis of Bath), in April 1810. The aggregate value at that time, was upwards of L.1500, and there were several single acres of equal value ([551]).

4. *Forests.*

In several parts of Scotland, more especially in the counties of Perth ([552]), Aberdeen, Elgin, and Inverness ([553]), there are extensive tracts, which naturally produce the Scotch fir *(Pinus sylvestris)*. This tree thrives to the height of 1400 feet above the level of the sea, and it has been remarked, that the timber which grows on the highest elevation, is of the best quality, and superior to any foreign timber that is imported. Owing to the distance of these fir woods from good markets and water carriage, the profit they yield is inconsiderable. By a contract for cutting a pine and birch forest in Glenmoriston, which is of great extent, the sum to be paid to the proprietor, was only L.800 per annum, for seven years. The great forest of Glenmore, belonging to the Duke of Gordon, sold only for L.10,000 ([554]). Nor have the forests of Rothiemurchus, nor of Braemar, (the property of the Earl of Fife), though the latter contains 100,000 fir-trees in full maturity, of superior quality ([555]), and many of them computed on an average, at from 150 to 200 cubical feet each, produced the sums that were expected. This is owing to their distance from the sea, and the expense of bringing them to market.

II. *Of Plantations.*

On various accounts, plantations merit particular attention. Besides answering the purposes of natural wood, for all the important objects for which that substance is applicable, planting is perhaps the only improvement of which, in many cases, extensive tracts are susceptible. Several sorts of trees also, may thus be introduced, which, though not indigenous, will, under proper management, thrive in a country. In this way, likewise, the climate is improved, by the shelter thus obtained; and the beauty of the scenery is heightened, by covering barren rocks, and bleak heaths, with the verdure of woods.

It is certainly a fortunate circumstance, that, with the exception of very high mountains, there is scarcely any portion of land, so poor, barren, rocky, or unproductive, as not to admit of this species of improvement, provided trees, suited to the quality of the soil, and the nature of the climate, are selected, and the proper modes of treating them are practised. But though there are inducements to plant, yet, unless in places where the demand is great, trees should not be reared in any quantity, upon land that may be made subservient to agriculture or productive pasture. Crops of grain, or herbage, will, in general, produce a much more expeditious and more profitable return ([559]).

Before a plantation is begun, the following points ought to be considered: 1. The manner in which young plants ought to be raised;—2. The trees best calculated for several soils and situations;—3. The manner in which they ought to be planted;—4. The expense of planting;—5. The mode of management;—and, 6. The probable profit.

1. Some have maintained, that it is better to raise the young plants in a nursery, than to sow the seed in the ground where the trees are to be raised. The late Mr Davis, author of the Wiltshire Report, whose skill and experience were doubtless considerable, contended, that where the oak was well managed, it would be bigger and taller at seven years old, when raised in the nursery, and its tap-root cut, than one uncut would be at ten ([560]). Strong objections, however, have been urged against the using of plants, raised in at least public nurseries, and more especially against the cutting of the tap-root.

Young trees should always be raised on good land, so as to carry a stock of health and strength with them from the nursery. They are thus furnished with abundance of roots, by means of which they are enabled to find nourishment, even in poor land, having more mouths to collect it. This doctrine, originally inculcated by Miller, the father of English gardening, is now almost universally admitted.

It is a material object, that the roots should have the means of growing without obstruction. In stiff heavy clays therefore, it is considered an advisable practice, to trench the ground two spits deep the year before the ground is planted, though at an expense of about L.8 per acre. But light land requires no digging ([561]).

2. The great variety of trees to be found in nurseries, puts it in the power of a planter, to procure a species calculated for his soil and climate, or for the situation in which he may happen to be placed in regard to market. The various sorts may be considered as adapted, 1. For elevated grounds;—2. For steep lands unfit for cultivation;—3. For low and moorish tracts;—4. For swampy grounds or bogs;—5. For the sea-coast;—and, 6. For lands of rather a superior quality.

1. *Plantations on elevated Lands.*—When judiciously raised, such plantations are productive of the most beneficial effects. By the warmth which the shelter of trees occasions, and the manure afforded from their leaves, heath is destroyed, and the growth of better herbage is promoted. The grasses which are thus brought forward, are sometimes three weeks earlier in spring, are better in summer, and are protracted for three weeks longer in autumn ([562]).

The trees that thrive best in an elevated situation, are, the larch;—the Scotch pine or fir;—the silver fir;—the mountain ash;—and the birch. In a medium elevation, the beech may likewise be cultivated.

The Larch, (*Pinus larix,* Linn.) ([563]).—The introduction of this species of tree into the British Isles, is perhaps the most important acquisition, in respect of timber, that this country has ever obtained. It is a more beautiful tree than the fir, vegetates more rapidly, and grows in situations where it cannot be raised to any advantage. The larch, when peeled, should be immediately put into water, to prevent its splitting; but when the trees are large, they should be cut into scantlings before they are watered. They should remain in the water six weeks, and when taken out, should be laid in the shade, where they are skreened from the sun, and upon rough wood, to prevent their touching the earth, which would be injurious to them. The larch adapts itself to a variety of soils and exposures; while the wood it furnishes is of the best quality, even though raised in elevated situations, and on soils of inferior quality. It will thrive at the height of 1200 feet above the level of the sea, and even higher. The wood is closer in its pores, and has fewer large knots than the Scotch fir. It is light, strong, and durable, and peculiarly suitable for roofs and floors of buildings, but is liable to cast or warp when used for doors and shutters. It is peculiarly fitted, from its property of burning with difficulty, for various uses in architecture. Its bark possesses, in a high degree, the tanning principle, and it is much esteemed for preparing calf skins for boot legs, answering better than oak bark for that purpose. Its growth is so rapid, that if the ground be tolerable, it becomes in thirty years, fit for various household and other purposes ([564]). It is well adapted to mill-work; and in ship-building, may be used, as a substitute for oak ([565]). It is found also, that the larch, from the droppings of its leaves, will, in the space of a few years, convert a barren heath, into grass land, worth from five to ten shillings per acre.

Some maintain, that the larch resists well the effects of being alternately wet and dry; but Mr Blaikie has found it so deficient in that respect, that he thinks it ought not to be employed for gate-posts, or other out-door purposes. Perhaps the difference of opinion in this matter is owing to the timber being used at different periods of its growth.

In some instances, the larch is liable to a disease, and its leaves are destroyed by insects, more especially in low and damp situations. By some, this disorder is attributed to want of circulation of air, from the trees being planted too close together. Where they stand bold and single, they are not liable to it. Others ascribe this circumstance to the present practice of raising plants, from the seed of trees that had not arrived at their full maturity, and sometimes even from layers which strike root. It is not improbable that the larch, originally introduced from the mountains of Carniola, will at length degenerate with us, at least as to perfecting healthy seed. Hence it would be advisable, to import annually, at least a portion of the seed used in our nurseries, from the Alpine regions.

In Norfolk the larch thrives well, for the space of twenty or thirty years, though planted upon a very light sandy soil. They then begin to decay, and soon after die. It is believed that the disease is owing to the roots of the tree having exhausted the surface soil, and penetrated into the calcareous subsoil, which is injurious to larch, although beech and other trees thrive well in it.

The Scotch Pine or Fir, (Pinus sylvestris, Linn.)—This tree is well calculated for peculiar situations. It thrives on the thinnest and driest soils; on the poorest exposed moorish ground, if not too wet, or overgrown with rein-deer moss; and may be planted successfully, wherever there is short heather, growing above gravel or sand; or sandy heaths near the sea shore; and on mossy soil, less than two feet in depth, but bottomed with gravel, and not clay. It thrives to the height of from 1000 to 1200 feet above the level of the sea, and its timber improves with the increased height of its elevation; but high winds are very destructive to this tree, and a fall of snow will destroy, or greatly injure, in the course of one night, sometimes one-third of a fir plantation ([566]). Some entertain the idea that Scotch firs will not succeed on a clayey soil. The contrary, however, has been found in Lanarkshire and in Ayrshire, where they grow on clay of the worst quality, and as impenetrable to water, as any subsoil can possibly be. Many firs are to be met with in those districts, above a hundred years old, of a great size, and containing *red wood* even to near their bark. It is probable therefore, that the modern plantations of fir, consist of that inferior sort, which has unfortunately been introduced into this country, and which, though its growth is quicker, is greatly inferior in value.

The timber of this tree is employed for several architectural and agricultural purposes. It produces a variety of useful substances ([567]), and though not so profitable as the larch ([568]), yet it possesses several advantages. It grows fast, and the wood may be used with advantage in farm-houses. The fir cones, and decayed wood, furnish the poor with fuel. The green boughs keep deer completely well in winter; and they save much hay, if given to sheep, in snows. The boughs are likewise of great use as firewood, in fences, &c. ([569]). To this may be added, its utility in ship-building: a very fine frigate of 800 tons, the *Glenmore*, having been entirely built of Scotch fir, except the masts. The late Mr Davis of Longleat was partial to this tree. He observes, that firs not only grow faster than forest trees, but that four firs will stand and thrive on a space of ground, which one oak will require; and that it is greatly preferable, to see a barren heath, even in the summer, covered with a grove of thriving Scotch firs, than with a parcel of half-starved stunted trees of any other description (570).

There are two varieties of Scotch fir, though usually planted as one and the same sort. Those with the broad and spreading tops stand to a great age, and become very large timber. Their spines grow more in clusters; they are shorter, and of a darker green colour than the spines of the conic headed trees. They are called "*The old Scotch fir*," or Baltic red wood timber. The other, with conic shaped heads, which die prematurely, are called "*The new Scotch fir*," or Canada pine. Those who wish to plant the true Scotch fir, will endeavour to procure the seed in future, either from the natural fir produced in the Highlands of Scotland, or from the woods in the province of Riga in the Baltic.

The Silver Fir.—This tree thrives well, reaches to a great age, and produces large timber on the Norfolk sandy soil, and its calcareous subsoil. One of these trees now standing in Holkham Park, planted by Mr Coke 46 years ago, measures 84 cubic inches of timber. The silver fir produces more valuable wood than any of the other firs.

An experienced planter (the Right Honourable William Adam), strongly recommends *the spruce* for a nurse (571), in preference to every other tree. In numerous instances, oaks and elms may be seen in his plantations, growing up, uninjured, in the bosom of spruces. This circumstance is easily accounted for. The deciduous trees above mentioned, send their roots downwards, the oak in particular, which, the longer it grows, derives more of its nourishment from a great depth. The spruce, on the other hand, spreading its roots along the surface, draws its nourishment from a different source. The spruce also, being thick-leaved, and its branches of a strong and unpliable nature, gives much protection, and does little injury to its neighbours. Rising in a regular and pointed cone, it leaves full scope for the spreading top of the oak; while, being much feathered at the bottom, it protects that tree, or any other it is intended to shelter, from being windwaved. In soils and situations however, where the spruce would grow but slowly, the Scotch fir is to be preferred as a nurse, as it will grow freely even in poor soils, is easier raised, and can be had at less expense.

One of the most important uses for which this tree is at present employed, is as nurse or shelter to young plantations, in which it is the object to rear more valuable timber. In this case, it is necessary gradually to weed out the Scotch fir, so as to furnish the trees, of which the plantation is finally to consist, with the proper supply of air and sun.

The Mountain-ash, (*Sorbus aucuparia*, Linn.)—This tree will grow at an elevation of about 2000 feet, and as it thrives well in dry and rocky soils, it is well calculated for exposed and elevated situations, and may be advantageously employed for the purposes of shelter. It is much cultivated of late in pleasure-grounds, on account of the beauty of its foliage, its flowers, and its fruit. The wood is of use where a hard and compact substance is required; and its bark possesses a considerable degree of the tanning principle, and leaves the substance tanned, more soft and pliant than the oak ([572]).

The Birch, (*Betula alba*, Linn.)—This tree is the natural decoration of a northern clime. It has been found growing naturally more than 1500 feet above the level of the sea. It will thrive almost any where, but succeeds best in a light dry soil; and bears better than any other tree, the severities of a northern clime ([573]). It is useful to the turner; in various kinds of machinery; for underprops in coal-pits; and in making sleepers for railways. A species of excellent vinous liquor has likewise been made from the birch ([574]). But its most important use has hitherto been too much neglected in this country. It is the bark of the birch tree that produces that glutinous, odoriferous, and inflammable gum or oil, which the Germans and Russians employ in tanning leather, and which gives it that peculiar odour, so hostile to insects ([575]).

The Beech, (*Fagus sylvatica*, Linn.)—This is a hardy tree, and will thrive in moderately elevated situations, particularly in calcareous soils, as chalk hills and downs, as well as in deep and sandy loams. It will likewise grow among limestone rocks, where soil is scarcely visible. The timber is valuable for certain husbandry purposes, as the bottom of carts and waggons. It is also very useful for beams of barns, or out-buildings, or boarding for stalls, either in stables or byres, as also where the flail is used, for thrashing floors, and for various kinds of machinery. It is also peculiarly well fitted for water-works of all descriptions; and it is used for the keels of ships. It is much employed in making chairs, bedsteads, and other articles of furniture;

and has lately been used as piles and planks for the foundation of Waterloo-bridge. It is remarked, that hardly any species of herbage will grow under beech.

In regard to plantations on elevated lands, it is to be remarked, that it is of great importance to plant them younger than is usually the case.

2. *Plantations on Steep Banks.*—The sides of hills, and banks of rivers, so difficult to cultivate, cannot be more advantageously occupied, than by trees. On the sides of hills, the ash and the sycamore, which have large resinous buds, and make large unpliable shoots, not liable to hurt or molest each other in the spring of the year, while they are tender, are the most likely to prosper; and more especially, if the situation be exposed to the south-west wind. In many parts of Gloucestershire and North Wiltshire, the profit made by planting *ash* with *willow* for underwood, on the cold and boggy soil of the sides of hills, is almost beyond credibility ([576]).

3. *Low and Moorish Tracts.*—The birch, the alder, and the willow, are well calculated for such soils: but there is reason to believe, that the *pitch-pine* of America would surpass every other tree in such situations. The largest trees of that species in Scotland were all planted, *by accident*, in wet ground, or swampy spots, abounding with springs. No tree is more profitable. It is by nature much smoother in its texture, and freer of knots, than the Scotch fir. The quantity of turpentine in the wood, prevents its being injured by wet, and renders it well calculated for decks of ships, dressers, weavers' looms, and other implements. It also resists the dry rot in joists and rafters. As it *never splinters*, it might be of great use in naval architecture.

The ash is also raised to advantage in damp situations, and will grow healthy and luxuriant on almost any soil, even upon low, moory, swampy spots, upon a level with the water; nay, it will vie on osier-beds with the aquatics ([577]). That the ash will thus thrive in such situations, is a circumstance of considerable importance, and not so generally known as it ought to be.

4. *Swampy Grounds, or Bogs.*—Trees that spread their roots on the surface, as Scotch fir and larch, also birch and poplars, and, according to recent experiments, the ash, are to be preferred on such grounds. Oaks, and other trees with a tap-root, which strike deep into the ground, will not answer, for the roots of no tree can live in the lower parts

of deep bogs, owing to the moisture they retain. The antiseptic quality, so universally to be met with in bogs, and which is so hostile to vegetation, ought first to be destroyed, by exposing the ground to the influence of the atmosphere, and mixing with the soil, some lime, limestone gravel, and other calcareous matters. Drainage, likewise, must not be neglected ([578]).

This description of soil, also, may be rendered highly valuable, if planted with willows or osiers. A statute acre will contain about 20,000 stock plants, eighteen inches distant from each other, and if six shoots grow on a stock, the amount is 120,000, which, at 10s. a thousand, the price given for them by the Commissioners of the Victualling-office at Deptford some years ago, would produce L.60 per statute acre. It is stated in the Ayrshire Report, that when the willow grows well, the shoots are ready for the market in three years, and will frequently sell for L.24 per acre. In eight years, the clear profit of an acre of the basket and coopers' willows, after paying rent and other charges, has amounted to L.38 ([579]). The profit from planting willows on the islands in the river Thames is great, but the real amount cannot be ascertained ([580]).

5. *Plantations on the Sea-Coast.*—The difficulty of raising plantations on the sea-coast, is well known. The land on which trees may be grown, might perhaps be more profitably employed for other purposes; but such is the advantage *of the shelter thus given to the neighbouring fields,* that it is of the greatest importance to remove the obstacles which have hitherto prevented the growth of trees in such exposed situations. Experience has shewn, that there are some species of trees better calculated than others, to resist the blasts of the ocean.

The *Pinaster*, or *sea pine*, is considered as peculiarly adapted for maritime situations ; and the valuable property it possesses, of resisting the gales of the Atlantic, was fully ascertained by the late Earl of Galloway, who planted some of them almost on the sea beach, which have become large and flourishing trees ([581]). In Nova Scotia, the Weymouth pine *(Pinus strobus)*, has been observed to withstand the rigour of the sea-blasts, better than any other tree. The late Dr Anderson ascertained, that the *Laburnum* will stand the sea-blasts, and shelter other trees; but it must be protected from hares, which are fond of its bark ([582]).

The Huntingdon willow, next to the pinaster, seems best calculated to withstand the baleful influence of the westerly winds on the sea-coast. It is cultivated at little expense, and grows faster than any other tree. Its wood and bark are likewise of considerable value. In twenty-eight years this species of willow has been known to rise to the height of fifty-eight feet, with a large trunk. A belt of this willow, opposed to the south-west, would form a speedy and effectual screen ([583]).

There is a particular species of oak, (an evergreen called the *Quercus ilex*), which grows spontaneously in the woods at Holkham, and flourishes there, even where exposed to the northern sea-blast. It is a different species from the *Quercus vivens*, or live oak of America ([584]).

The Quercus cerris.—The Turkey oak grows in great luxuriance within reach of the sea breeze at Holkham. Some of those trees are near 100 years old, and are fine timber trees of large dimensions.

The seeds of a tree, hitherto unknown in Europe, have recently been brought into this country from Demerara, (the Corsida), which, it is said, will grow with vigour even in salt water.

The plane or sycamore is likewise an excellent defence against sea-storms. It is less affected by the blast than almost any tree, and is upon that account well fitted to form a screen of defence against the sea-breeze. It has been remarked, that both the ash and the common sycamore have large resinous buds, and that their shoots, though large, are not liable to injure, or to lash each other, in the spring of the year, when they are tender; and thence are the best adapted for exposed situations ([585]). The ash thrives well near the sea, on account of the lateness of its foliage. The oriental and occidental planes, however, are extremely tender, and a few years ago a number of them were blasted to the west of London.

The *Tamarix Gallica* thrives rapidly in situations most exposed to the blast of the sea. It makes an excellent hedge, and, in seven years, has grown from ten to twelve feet in height, and feathered to the very bottom. It thrives well even about the Lizard in Cornwall, and there cannot be a more exposed situation ([586]). It does not however, stand frost well, and, on that account, the *Tamarix Germanica*, being a hardier shrub, ought to be preferred in the bleaker situations.

The *Flowering elder*, *(Sambucus nigra)*, is found peculiarly capable of resisting the influence of the sea. It may be used as a nurse to protect other plants from the sea-spray and the storm. Cuttings of it will thrive in the sand of the sea-shore, and will grow rapidly, particularly if the bottom be moist.

At Holkham, where the northern ocean washes the domain, the sea buckthorn flourishes upon the meals, or hills of sand, thrown up by the winds and waves upon the sea-beach; and forms with the common elder, and the tamarisk, the best barrier, or outer line of plantations on the sea-coast. The sycamore, the evergreen oak, and the Huntingdon willow form the second line, and the Scotch and silver firs, with the elm, rank third.

The oak, ash, sweet chestnut, locust acacia, lime and beech occupy the interior of the woods, with hasel for underwood, and interspersed with horse chestnuts, hornbeams, and evergreen oaks to nourish and protect the stems of the principal timber trees; for it is material to observe, that it is more necessary to shelter *the stems* than the tops of timber trees.

The difficulties, however, attending the raising of forest and even fruit trees on the sea-coast, have been surmounted by a simple expedient. There is reason to believe, that the neighbourhood of the sea is unfavourable to the growth of timber, not so much owing to the spray, as to the violence and frequency of the wind, more especially when the plants are young; for whenever shelter from the wind is afforded, the trees grow equally well on the sea-coast, as in the more inland districts ([587]). Impressed with these ideas, the Rev. Mr Formby of Lancashire, adopted the plan of sheltering the young plants from the winds, by raising sods round them, and guarding their tender shoots from the wintry blasts, until they had taken firm root in the ground. By this means, he has successfully planted some acres of land with forest trees, which are flourishing and ornamental to the country; and has succeeded in raising plantation and fruit trees nearer the sea, than was thought practicable, till he had effected it ([588]).

6. *Plantations on Land of rather superior Quality.*—On soils entitled to that description, the oak, the ash, the Spanish chestnut ([589]), and the elm, deserve the perference.

The properties of the oak, in regard both to the bark and timber, being so generally known, it would be superfluous here to speak of them. The timber of the oak is lasting, for in many ancient buildings, it has remained uninjured, after six or seven centuries have elapsed. Though not so durable as the locust acacia, or the sweet chestnut, yet it has decided advantages over both. It grows to a much larger size than the acacia, and is much sounder than the full grown sweet chestnut. Its bark is also a valuable consideration.

Deep clay, or loamy soils therefore, where they are of too cold a quality to be well adapted for arable culture, cannot be better occupied than in the production of oak.

The ash seems to be entitled, in point of importance and of use, to rank next to the oak ([590]). In size, as well as in beauty, a full-grown ash is one of our finest trees. Its foliage, though late in appearing, (which is favourable to its success near the sea), and early in falling off, is peculiarly elegant ([591]). Unfortunately the ash, if planted in hedge-rows, is injurious to land when under cultivation; and is likewise unfavourable to the dairy, as its leaves, if they get mixed with the pastures of cows in autumn, communicate an incurable bad taste to their milk, and the butter made from it. Hence the propriety of raising the ash in woods, instead of hedge-rows ([592]).

The elm is a valuable tree. It makes good shelter; its shades do little harm to hedges, and neither its leaves nor its roots do any injury to grass, or to arable lands ([593]). Its timber answers various useful purposes, and by many it is considered equally profitable as the oak; for though the same quantities of timber from the oak and elm, are in value only at the rate of from two to three, yet the growth of the latter usually, is to the former, as three is to two; consequently they are, in point of value, on the same footing ([594]).

There are also some other trees, which, though of a subordinate character, may be turned to a good account; as the *Salix cœrulea*, or the French willow; the *Populus monilifera*, or the Canada poplar; also, the wild cherry, *Prunus cerasus*, which ought to be extensively cultivated, as its timber, when of forty or fifty years' growth, is valuable for all building purposes ([595]); and the American live oak, or *Quercus vivens*, so celebrated by the Americans, for its durability as ship timber, and for every purpose where it is likely to be exposed to the variation of the weather.

3. There are various modes in which trees may be planted, each of which has its advantages. 1. Where the climate is bleak, and shelter is required, they ought to be planted in large masses; for though the outskirts may be stunted in their growth by wind-waving, yet the plantation will secure the growth of the interior, and principal part of it. 2. Belts of planting are likewise of great use. They oppose and break the current of winds, forming eddies,

which are much softer and milder in their influence. By the shelter which they afford, the soil is ameliorated, and the produce is improved, even in districts naturally bleak and unfertile. A very frequent error in the construction of these belts is, that of making them too narrow. They should never be of less breadth than from fifty to sixty yards, except when the land is valuable, or the property circumscribed. When narrow, their effect in moderating the wind, may be greatly aided, by tall hedges. 3. In some districts small clumps are planted, which, if judiciously executed, are ornamental, and afford much shelter to a country bare of wood. 4. To plant the corners of inclosed fields, has of late been much recommended. The inducements to this plan are great. Two-thirds of the space are already inclosed, the angle cannot be conveniently brought under the plough, the soil is rich and in good order, and the beauty of the country is promoted; yet, if the corners are made very small, the inclosure of such spots, and the keeping of them in repair, is attended with considerable expense. 5. Planting the gardens of farmers and cottagers is practised on some estates, and has a good effect in point of appearance; but it is detrimental to the productions of the garden, and ought never to be attempted where fruit-trees will grow. 6. Hedge-rows are highly ornamental; they give shelter, and in process of time, become timber; but unless properly managed, by judicious and high pruning ([596]), they ruin the hedge, injure the adjacent grounds by their roots and shade, and when planted on the sides of roads, do great injury, by keeping them wet. (See Chapter III.) 7. Shade-trees, when judiciously planted in fields, are useful in hot weather, as a shade for cattle. The bird-cherry is the tree that bears transplantation at a much larger size than most others, and its wood is valuable. The beech, the sycamore, and lime, are likewise well calculated for that purpose. 8. Pollards do not seem to contribute much to ornament, and no other advantage is derived from them, except in districts, where fuel is extremely scarce ([597]). Nor is cutting off the branches of trees in hedge-rows, making what is called a besom-head, to be recommended. It lessens the agitation produced by winds, and deprives the tree of what may be deemed its salutary exercise, while the loss of the branches, prevents it from receiving the nourishment it would otherwise derive, through the medium of the leaves they would produce ([598]).

4. The expense of making a plantation, must vary accord-

ing to the size and figure of the field planted, the kind of fence with which it is inclosed, the extent of draining which it may require, and the number, sort, and age of the trees of which they are composed. In Galloway the expense of planting by contract is L.5 per acre ([599]). But on the whole, the following estimate is not too high, where thorough justice is done to the plantation, and where the trees are of a valuable description.

Draining,	L.0	15	0
Price of plants,	3	10	0
Putting in,	0	18	0
	L.5	3	0

The expense of inclosing varies from 10s. to L.5 per acre, according to the size and shape of the inclosure, and the materials of which it is made.

Though plantations may be done, therefore, cheaper by contract, yet being executed in a careless and imperfect manner, and frequently unthriving seedlings used, they generally fail; nor can any dependence be placed on the success of a plantation, unless all the necessary steps are taken with skill and attention. Draining, in particular, to which a contractor in general pays little attention, is essential. There are few species of trees that will thrive in a wet soil; and a large proportion of those cultivated in plantations, are injured or destroyed by superabundant moisture. Drains ought therefore to be made with peculiar care, and it is highly injurious to neglect them afterwards, and to allow them to fill up. If a plantation is worth the forming and fencing, it is surely worth the extra expense of making, and of keeping up drains, on which its future success principally depends.

5. Plantations are often made in ground encumbered with stones or rock, where no preparation can be made, but pitting the ground for the plants; it is of use to dig the pits five or six months before the seedlings are inserted, the mould and even the turf being thus better calculated to nourish them. Where it is practicable, it is an expensive, but useful preparation, to trench or plough the ground before the trees are planted; and by some, cultivating roots, for two or three years afterwards, is recommended. The quantity of plants varies from 2000 to 4000 per statute acre, according to the bleakness of the situation, and the richness of the ground. A new mode of planting furze-fields has

been tried in Sussex with success. After having produced for many years, so exhausting a crop as furze, the land is not fit for arable crops. The vacant places are, therefore, planted, principally with ash, and the furze cut out as the trees increase. Being found of little value for lime-kilns, the furze is spread out and burnt on land prepared for turnips, and the result is highly satisfactory, yielding excellent crops of turnips, without any other manure ([600]).

On the Management of Mixed Woods.

Prejudices are entertained, against the mixture of different kinds of trees in the same plantation; but it certainly contributes highly to ornament, affording an endless variety of shade and colour; and is necessary, to afford the protection and shelter of the quicker growing, and hardier trees, to those which are more tender, and of slower growth.

It is evident however, that where a great variety of trees are planted, they will be more difficult to manage, than where they are all of the same sort.

The following observations on that subject, coming from so superior a planter as Mr Blaikie, merits peculiar attention.

The oak ought to be the basis of all plantations in this country, wherever it is likely to thrive; but as it is sometimes difficult to ascertain, whether the soil and situation are calculated for that tree, it is advisable, in all cases where a mixture of forest trees are planted, to have, besides hasel, and other underwood, *not less* than 300 oak plants per acre, intermixed with other timber trees. When the other varieties of trees are found to thrive better than oaks, in such mixed woods, the most unthrifty oaks should be cut off, close to the ground, when their stubs will produce good underwood. Ash, elm, and sweet chestnuts should also be raised in such plantations much thicker than is required to stand for timber, and after being thinned, their stubs produce abundance of underwood. The finest shoots should be selected, to stand for saplings or waivers, to supply any deficiencies in the timber trees which may occur. In a few years, timber tree seedlings, particularly ash, will rise abundantly among the underwood. Those seedlings should be selected as waivers, in preference to stub shoots. By those means, mixed woods become well stocked both with timber trees, and underwood of various ages, and of the most profitable description. Woods so managed, are not only profitable, when times will admit of profit to arise from that description of property, but they are also ornamental in a high degree, and never cease to be so, even immediately after the cutting and thinning processes, if executed judiciously; because, when trees of so many varieties, and of such different ages and growths, are intermixed, no great number standing together, or near each other, ever arrive at *maturity*, and require to be felled at the same time; consequently, no large gaps or wide vacant spaces are ever perceptible in those woods, more than is necessary to give light and air to the renewed trees, and to enable them to shew their natural-formed picturesque heads to advantage. The landscape being occasionally enriched, by a branching, rugged-topped old Scotch fir of the right sort, standing prominent; while evergreen oaks, hornbeams, horse-chestnuts, and other trees of medium growth, are interspersed among the taller-stemmed timber trees. This is a faint description of the present state, order, and condition of the old woods in Holkham park. How much more preferable, in every respect, are mixed woods, such as those here described, to groves, or dense masses of trees of the same growth, without underwood or copse woods, and without an intermixture of useful and ornamental timber trees!

On the Necessity of thinning Plantations, the rules to be observed in managing that operation, and the means of remedying the mischiefs arising from neglecting it.

Plantations intended for mixed woods, however judiciously they may have been planned and executed in the first instance, never can be brought into proper order, and maintained in health and prosperity, neither will they ever become ornamental, if the thinning process is not commenced at an early period, and strictly attended to throughout the whole progress of their growth.

More plantations are ruined from neglect of thinning, than from any other cause. It is a rare instance to see a plantation thinned in a rational or profitable manner. The trees are generally allowed to stand many years after planting, however thick they may have been planted, without any thinning whatever, otherwise than by wood stealers. The soil becomes exhausted, and the trees having, to a great extent, overtopped and destroyed each other, and the stems of the survivors having been drawn up so tall, and so feeble as not to be able to support their tops, after the dead and decaying trees are removed. The destruction is then complete; for it is quite impossible to thin plantations of that description, and maintain the selected trees in a healthy state, or even to keep them alive, for die they must prematurely, under such gross mismanagement. The best remedy for such a calamity, is to fell the whole mass of trees in the plantations at once, and to renew them in the following manner.

The whole of the trees having been felled, as here recommended, the trunks of the oak, ash, elm, sweet chestnut, and other trees likely to throw out good shoots, should be cut off close by the ground, and their stubs carefully preserved from injury by wheels of carriages, when clearing the woods, or otherwise; and the roots of firs, and all other trees which do not throw up shoots from the stubs, should be grubbed up. The grubbing should be done in autumn, and the holes left open all winter, for the purpose of fertilizing the soil. Well-selected young forest trees should be planted in those holes in spring. No variety of tree answers so well for filling up, or removing old plantations, as the locust acacia. It is a strong-rooted plant, and so tenacious of life that it seldom fails after transplanting, however large the plants may be, and however unfavourable the soil and situation where they are planted. Hares and rabbits being particularly fond of the bark of locust acacias, the stems of those trees, when young, require to be protected against their depredations.

The surface of the ground in the holes where the young forest trees are planted, should be hoed two or three times a-year, and for two or three successive years after planting. That operation not only destroys weeds, but the aration greatly promotes the growth of the young trees. The strong shoots which rise from the reserved stubs of the trees, previously filled, should be cut in, and kept within due bounds, so that they may be prevented from smothering the new planted trees, which they otherwise would do. No farm stock of any description should be allowed to enter the renewed plantations. Hares and rabbits should also be excluded as much as possible. The selecting and thinning of the young shoots, rising from the roots and stubs in the renewed plantations, should be early attended to, and judiciously performed.

On Pruning.

Great attention and sound judgment are required in the management of mixed plantations. For, on the one hand, if left too thick, the trees are injured, and the underwood destroyed; while on the other hand, if left too thin, the stems of the selected trees do not rise to proper heights, and nature does not perform the pruning operation on their stems, so that recourse must then be had to artificial means, for checking and removing over-luxuriant side branches, a circumstance by no means desirable, as *natural pruning* is much preferable to artificial means.

When proper attention is paid to thinning well-arranged mixed plantations, but little artificial pruning is required in training timber trees. Because the proximity of the branches of other trees, preventing the light and air, and other nourishment, from freely reaching the strong side branches of the selected trees, those are in consequence checked in their growth,—they soon become overtopped by the crown branches of the trees of which they form members, dwindle away, and are ultimately pinched off, by the gradual increase of the stem timber. Hence the term "natural pruning."

The remarks on pruning which follow, apply generally to oaks and all other hard-wood forest trees, and in a limited degree only to the fir tribe.

When large branches are cut off close from the stems of healthy thriving trees, the bark and young wood soon grow over the wounds, so that the stems of the trees appear quite perfect. But that is deception, for no adhesion or union takes place between the young wood and the stumps of amputated large branches. Sap wood unites with other sap wood, but never with heart wood. By the union of the bark and sap wood over the stumps of the branches, they are close covered, or as it has been called, "sealed "up," and the sap which flows annually in the trees, condensing round the stumps of the branches, promotes decay and rot, which soon communicates to the whole tree. The disease is fatal, and the only remedy is to fell the mangled trees, and replant.

Unfortunately, the king of the forest, "the oak," is more susceptible of injury from injudicious close pruning, and has been more generally practised upon in that way, than most other valuable timber trees. The injury, and ultimate loss, will therefore be national, as well as individual. Old oak trees which have done growing, are but little, if in any degree, injured by close pruning, because bark and young wood do not grow over the wounds of trees arrived at maturity, and the flow of sap does not injure them, as in vigorous growing trees.

Natural pruning has been here stated to be preferable to artificial. But in cases where trees have room to expand their branches, as in woods stocked with underwood, and in hedge rows, they throw out over-luxuriant side branches, and if those are not kept within due bounds, they greatly injure the underwood in one case, and the hedge plants in the rows, and corn in the adjoining fields, in the other. Those trees, therefore, require to be pruned to a certain extent by artificial means.

When side branches require to be cut from trees when mere saplings, they may be pruned close from their stems, a few at a time, and the wounds soon heal over. But when trees, however young they may be, are entirely stripped of their side branches, at one close pruning operation, they are immediately checked in their growth, greatly injured, and in many instances, totally spoiled.

The great error in close pruning, has arisen from the difficulty in defining the exact age of the trees, or size of the branches when close pruning should cease, and other methods for effecting the same purpose should be resorted to. It is a wise maxim, when doubts arise, to hazard erring on the safe side; and as close pruning cannot be safely practised upon large trees, it is prudent to discontinue that practice as soon as the plants begin to assume the character of trees.

The system of pruning trees, called "*foreshortening*," is admirably adapted to checking the growth of over-luxuriant side branches, without either impairing the health of the trees, or disfiguring them in appearance; and the beneficial effect of the practice is, that it disposes of the pruned branches in the same manner as in natural pruning, hereafter explained. In the foreshortening process, the over-luxuriant side-branches are cut off immediately above *live* secondary branches springing from them. When the branch to be shortened is small, it is cut off above the first lateral shoot, or secondary branch. When the branch is of a larger size, it is cut off above the second lateral; and when larger still, it is cut off above the third; and so on, always regulating the distance from the stem, by the size of the branch.

The object of this practice is, to check the current of sap flowing in the strong side branches, and divert it into more profitable channels. These are the crown branches, and the stems of the trees above the foreshortened branches. The stems increase in size, in proportion to the additional quantity of sap thrown into them, and the desired object is then effected; for the crown branches soon expand over the foreshortened side branches, and those in consequence soon begin to decay. They die gradually, dwindle away, and their stumps are ultimately pushed out, and pinched off by the increased size of the stem timber. By these means, the operations of nature, in what has been called "natural "pruning," are closely imitated in the result of pruning by foreshortening, as here described. It is desirable, that all persons who practise close pruning large trees, should satisfy themselves, as to the accuracy of the assertions here made in regard to the effects of that practice; and that they may readily do, by opening some of the places where branches had been cut off close, and the bark and new wood healed over the wounds. Those places are denoted by round prominences on the stems.

In managing plantations, a most material object is, to give a due proportion of air, and of shelter. In many cases, plantations, which have been well attended to in respect of *inclosing, draining, and properly planting*, have thriven well for the first 12 or 15 years, yet in 15 years more, the forest trees have been ruined, by allowing the Scotch fir and larch, which had been judiciously planted for shelter, to remain for 25 or 30 years. The oak and the ash have been partly destroyed, and those which remain are, for want of air, so *drawn up*, and left in such a debilitated state, that though their oppressors be at length removed, they cannot support themselves; and the few that can stand, from the sudden transition which they have undergone, immediately stagnate, and become overgrown with moss ([601]).

While the engrafting of fruit-trees has been found so advantageous, the same operation with forest-trees, has likewise been tried with success, and is certainly entitled to more attention than hitherto has been paid to it ([602]).

6. In Holland, tall forest-trees, 20 feet high, are transplanted every third year, and can be removed without much risk of going back. A ship load of such forest-trees has been sent from Holland to Russia, many of them from 20 to 25 feet in height, and very few of them missed ([603]). The practice of transplanting trees, has been reduced to a regular system, by an able friend to useful discoveries, (Sir Henry

Steuart), whose work on that subject justly merits the encomiums which have been bestowed upon it.

7. The profit of a plantation must, in a great measure, depend upon a number of local circumstances. The expense is immediate, and can be easily ascertained; but the returns are distant, and the planter is disposed to form too sanguine expectations for the future.

In Somersetshire, land not worth 3s. per acre, in a state of pasturage, has been planted with Scotch fir, which at 30 years old, was worth L.30 per acre ([604]). Scotch firs planted in Galloway, on land of the same value, have been estimated worth from L.24 to L.32 per statute acre ([605]).

In Clydesdale, Scotch fir, planted on poor land, in the lower part of the county of Lanark, sells at from L.20 to L.25 per acre, at 25 years' growth, and at upwards of L.80 when it reaches 50 or 60 years ([606]). But this is in the immediate vicinity of Glasgow, of the Clyde iron-works, and of many extensive manufactories.

Oak must always be valuable on account of the bark; but unless in the neighbourhood of large towns, of extensive manufactures, or water-carriage, the estimates commonly given of the profit derivable from plantations, are in general exaggerated. At the same time, there is no mode by which poor soils can be more advantageously occupied; and stony or rocky land, cannot be so profitably employed, in any other way. Indeed, on land properly situated, and calculated for that purpose, no speculation can be more pleasing, and, in some cases, more lucrative, than that of planting. The only objection is, the length of time required to bring it to perfection ([607]). But this ought not to have much weight, as the benefit must accrue, either to the planter or his heirs; and where he has a numerous family, there is no means, by which its younger branches, can be more easily provided for ([608]). If it be profitable, however, to plant new woods, it is certainly much more so, to protect those that are already planted, and to restore them from a state of decay ([609]).

On the subject of plantations, it is necessary to observe, how important it is, to discriminate between the different species of the same tree; since it frequently happens, that two or three distinct species, which require different situations as to climate, have been occasionally confounded in the same plantation. This discrimination is effected, with much ability, in a work printed in the Memoirs of the Caledonian Horticultural Society ([610]), in so far as regards the trees usually grown in Scotland. The advantages and defects of each species are there pointed out; and hints furnished, by the adoption of which, the intelligent and public-spirited planter, may ensure the most essential benefits, to himself, his successors, and to his country.

In estimating the value of plantations also, it is not the mere price of the timber at any given age, that is to be looked to. For the ornament they form upon property, and the shelter they yield to the land, the crops, and the cattle, are matters of nearly equal, and in many instances of much greater importance, than the value of the timber when cut.

Concluding Observations to Chapter IV.

Such are the various modes of occupying the soil, in a temperate climate, like that of Great Britain. It results from the whole investigation, that in such a climate, there is hardly a spot on the surface, excepting the summits of bleak mountains, that may not be employed, to some purpose advantageous to man. Where the soil is capable of cultivation, valuable crops of grain, of artificial grasses, and other beneficial articles, may be annually procured from it; and even the most barren spots will produce, either profitable herbage, or some useful species of timber.

CHAP. V.

ON THE MEANS OF IMPROVING THE AGRICULTURAL STATE OF A COUNTRY.

"Agriculture is the great art, which every government ought to protect;—every proprietor of land to practise;—and every inquirer into nature to improve [1]".

Introductory Observations on the Importance of Agriculture.

The prosperity of a nation, possessing an extent of territory sufficient for maintaining its inhabitants, chiefly depends; 1. Upon the quantity of surplus produce derived from the soil, after defraying the expenses of cultivation; 2. Upon that surplus produce obtaining such a price at market, as will encourage reproduction; and, 3. Upon the cultivator having such a command of capital, as may enable him to carry on his business with energy.

1. The surplus produce arises, from that inestimable quality possessed by the soil, which enables it, in proportion as it is skilfully managed, to furnish maintenance, for a greater number of persons, than are required for its cultivation. Thence proceed, the profits of the farmers;—the rents of the landlord;—the subsistence of the manufacturer, and merchant;—and the greater proportion of the income of the state. That surplus marketable produce therefore, is justly considered to be, the main spring, not only of political power, but also of personal enjoyment. When that surplus produce does not exist, (unless in circumstances of a very peculiar nature) [2], there can be no flourishing towns;—no military or naval force;—none of the superior arts;—none of the finer manufactures;—no learning;—none of the conveniences and luxuries of foreign countries; and none of that cultivated and polished society at home, which not only elevates and dignifies the individual, but also extends its beneficial influence throughout the whole mass of the community [3]. What exertions ought not then to be made, and what encouragement ought not to be given, to preserve, or to increase so essential a resource, the foundation of our national prosperity!

In order to form some idea, of the amount of the surplus marketable produce, on very different soils, under a judicious system of cultivation, the following statements were drawn up, by two intelligent farmers, respecting that amount, in their respective occupations, the one possessing land principally clay, the other a light, friable and loamy soil, favourable to the growth of turnips.

Mr Brown of Markle, in East-Lothian, occupies a farm of 670 English acres, on which, in consequence of almost all his servants being married, there is a population of 91 persons of all ages. Upon an average of years, the produce of 80 English acres is consumed on the farm, or given to the servants as wages, as nearly the whole of them are paid in grain, and have cows kept for their use, both summer and winter. About 90 acres are required for raising corn, clover, tares, and hay, for the working stock, and 45 acres to furnish seed corn. One hundred acres are in an unproductive state, that is, in summer fallow, or grass for young horses not employed in labour, and in fences, roads, stackyards, or devoted to purposes from which no direct produce is returned. Four acres are given to the servants, for raising flax, as a part of their wages; in all 319 acres; so there only remain 351 acres for raising surplus produce. Of these, about 120 acres are in pasture-grass for sheep and cattle, in clover for soiling, or in turnips. This leaves 231 acres for raising disposable grain, the produce of which may be stated at nine hundred and fifty quarters, on an average of seasons. On the whole, he calculates, the surplus marketable produce of his farm, on an average, at eleven bushels and a fourth of corn, and twenty four pounds and a half avoirdupois weight of butchers' meat, for every English acre in his possession (4).

Mr Walker of Mellendean in Roxburghshire, on the extensive tract of arable land which he cultivates, (2866 English acres), with a population of 250 souls depending on its cultivation for subsistence, sends, of surplus produce, to market, 3551 quarters of grain, and 7000 stones of butchers' meat; or, ten bushels of grain, and thirty-five pounds avoirdupois weight of butchers' meat, for every acre in his possession (5).

To these estimates of surplus produce, there are to be added, the hides, the skins, the wool, the tallow, and a variety of other articles, the basis of many important manufactures, the value of which, though it is impossible to give its amount correctly, from its great uncertainty, and the fluctuation of prices, must be very considerable.

If such are the beneficial effects that result from cultivating the soil, (and the facts are established beyond contradiction), what source, either of domestic industry, or of foreign commerce, can in any respect be put in competition with such a mine of wealth, when extended over a great empire (6)?

2. But the prosperity of a nation, as already observed, depends not only on having a great marketable surplus, but also on its disposable produce, fetching such a price, as to encourage reproduction. This was the case during the last war; and hence the nation was enabled, to persevere in it for so many years, and finally to bring it to a successful conclusion. By means of a great surplus of agricultural productions, sold at a high price, the farmer and his landlord were placed in a condition to pay very heavy taxes to government;—to engage in improvements of every description;—to furnish employment to a numerous body of labourers, to whom the price of bread was of little consequence, while work was always to be had, at wages proportioned to the price of corn;—and to consume immense quantities of merchandize, and articles of manufacture, by means of which, those two branches of national industry were supported, when they were in a great measure deprived of foreign markets. History does not furnish an example of a nation, which *abroad*, made such incredible exertions, while *at home*, so many millions of people, enjoyed all the necessaries, the comforts, and most of them the luxuries of life; the whole originating in prosperous agriculture, without which, our manufacturing industry, our commercial relations, or the necessary operations of our finances, could not have been carried on.

3. Nor is it alone sufficient, that the farmer should have a price adequate to promote reproduction: he should likewise have such a command of capital, (and if it must be borrowed, to be attainable at a moderate rate of interest), as will enable him to carry on his business with energy. Indeed, where capital or credit is joined to skill in agriculture, it lays the foundation of general prosperity. It will not be disputed, that a hundred persons may be put to the greatest inconvenience, because one individual *at the head of a chain of circulation*, cannot pay one hundred pounds. Enable him to pay that sum, and progressively, those connected with him are relieved. "But it is *the farmer* who is the first "link, in the great chain of national circulation." When he is supplied with money, he is enabled to pay his rent regularly;—his landlord is thus enabled, not only to employ

a number of labourers, but to purchase goods, from the British manufacturer, and the foreign merchant;—the latter finding thus a demand for foreign goods, is enabled, in return, to export British manufactures to foreign markets. By means of an abundant circulation also, the revenue is paid without difficulty, it is regularly remitted, and furnishes the means of paying the dividends due to the stockholders; the credit of the country is thus maintained, and every class in the community prospers. The whole, it is evident, *originates with the farmer*, the first link in the great chain of circulation, whose basis is the plough (7).

The superior importance of agriculture, has been recently proved, in a manner so convincing, and indeed unanswerable, that the question may now be considered as at rest. It is well known, that all the resources of the country were put to the test, by the strict manner in which the tax on income was ultimately exacted (8). By analysing therefore, the produce of that tax, under all its several branches, the real foundations of our national wealth and prosperity may be ascertained, with a degree of correctness, previously unattainable. The result of the inquiry is as follows:

1. Taxes on landed property,		£. 4,257,247
2. Ditto, on the farmers, or occupiers of land,		2,176,228
Total agricultural classes,		£. 6,433,475
3. Taxes on commercial property,	£.2,000,000	
4. Ditto on professions,	1,021,187	
		3,021,187
Difference in favour of the agricultural classes (9),		£.3,412,283

Hence it appears, that during that eventful period, when the ignorant and the prejudiced supposed, that we existed solely by trade, and that we ought to be considered merely as a nation of *shopkeepers*, it was the wealth arising from the productions of the soil, that chiefly enabled us to go on; it was successful agriculture, that furnished us with the means of carrying on the contest, and of bringing it to a triumphant conclusion.

Nor is this subject to be dwelt on solely as a question of finance. Let it be considered, that it is the land which furnishes the raw materials of the greater part of our manufactures; that the proprietors and occupiers of land, are the best customers of our manufacturers and merchants; and that through them, the greater part of all other professions gain their livelihood. The fundholders also must be aware, that upon the prosperity of agriculture, the regular payments of their dividends must principally depend. *For it is to be observed, that as the property-tax was imposed on all the classes of the community, in proportion to their supposed wealth or income, hence, we may conclude, that the taxes payable in every other way, by each class, and every individual in each class, who spent his income, were probably paid, in nearly the same proportion, as the tax on property.*

It cannot, at the same time be doubted, that the agricultural classes are much indebted to those employed in trade and manufactures, for being the means of consuming the produce of the soil. But still, it is the surplus productions of agriculture, raised under the superintendence of the owners of the soil, and by the skill and industry of those who occupy it, which constitute the real basis of our national prosperity; and exported manufactures, may be considered as nothing else, that so much beef, mutton, wheat, barley, &c. converted into another, and more convenient shape. Where manufacturers however, are fed by the productions of foreign industry, and when the articles they manufacture are produced from foreign raw materials, as fine wool, &c. &c. instead of being an advantage, they have the effect of depreciating the value, checking the improvement of domestic agricultural productions, and bringing foreign articles into competition with them, by means of British capital.

It likewise appears, from the following statement, that the occupiers of land form a great, as well as valuable body; and are much superior in number, as well as financial productiveness, to the other classes in the community.

		No. of Persons.
1. Occupiers of land, with incomes under L.50 per annum, who were thence exempted from the tax on property, ...		141,778
2. Occupiers from L.50 to L.150 per annum, ...	432,534	
3. Occupiers above L.150, ...	42,062 [10]	
		474,596
Total occupiers of land, independent of artificers and others connected with agriculture, ...		589,374

When it is considered, how usefully this numerous class of respectable and industrious individuals are employed;—that by the last enumeration of the population of England, Wales, and Scotland, the number of families connected with agriculture, including artificers, amounts to 895,998 ([11]);—that owing to the number of servants employed by farmers, each family cannot be estimated at less than six, or about 5,400,000 souls in all;—and that besides the numbers who are *directly* dependent on agriculture for their subsistence, there are several millions *indirectly* connected with it;—we must be sensible that too little encouragement has been given to agricultural exertions, and that the attention of the public at large, has hitherto been too seldom directed to the improvement of the soil, or to the interests of those who cultivate it.

The number of persons employed in trade and professions, assessed to the property-tax, stood thus:

		No. of Persons.
1. Persons in trade and professions under L. 50 per annum, and thence exempt from the tax, ...		100,760
2. Above L.50 and under L.150, ...	117,306	
3. From L.150 to L.1000, ...	31,928	
4. From L.1000 and upwards, ...	3,692	
		152,926
Total, ...		253,686

Consequently, there were 474,596 *actual contributors* to the property-tax, among the agricultural classes, and only 152,926 in trades, and all other professions, making the number of actual contributors connected with agriculture, more than all the other classes put together, 321,670.

These statements must satisfy every impartial individual, that the strength and resources of this country, principally arise from the productions of the soil;—*that the land, is the basis of our national wealth* ([12]); and that on the amount, and the value of its productions, our commerce and manufactures, and the payment of the public creditors, in a great measure depend. The revenues of the church, by far the largest proportion of the payments to the poor, and various other public charges, are likewise payable from the same source. Hence, nothing can be more impolitic, than to neglect the adoption of any measure, by which the interests of agriculture may be promoted; or more hazardous, than to take any step, by which its prosperity can be impaired, or those who live by it, reduced to poverty or ruin.

The means for promoting the agricultural prosperity of the country, therefore, merit our peculiar attention ([13]).

It has long been considered as an incontrovertible proposition, and approaching to the nature of an axiom, " That whoever could make two ears of corn, or two blades of grass, to grow upon a spot, where only one had grown before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

This however, cannot be admitted, for there are no means, by which such immense benefits can be conferred upon agriculture, as by a judicious system of civil polity. In fact, the prosperity of agriculture, *depends upon the politician.* The better and the more equitable the civil polity of a country, the more perfect will its agriculture become. Those politicians or statesmen therefore, who, by removing every obstacle, and furnishing every proper encouragement to agriculture, promote its advancement, have a higher claim to the gratitude of mankind, than those who have merely performed a secondary or practical part, which part, they never could have performed at all, but under the protection of wise laws, regularly administered, and executed with impartiality and vigour.

This leads to the most important discussion, perhaps in the whole range of political inquiry, and respecting which the most ill-founded prejudices are unfortunately entertained, namely, " What public attention and encouragement, for the advancement of agriculture, ought a wise government to bestow?"

Many able men, *reasoning solely from the abuses to which the system of encouragement is liable,* have thence been induced to condemn this policy, and to recommend, that of giving to individuals, the entire freedom of exercising their industry, in their own way, without any legislative interference whatever. They dwell much, on the reply once made by some of the principal merchants of France, to the celebrated Colbert, who having asked, *What government could do for them?* was answered, " Laissez nous faire," *(Let us alone).* On the other hand, they totally reprobate *the mercantile system* as they call it, (or a series of laws which have been enacted in this country, for promoting the prosperity of commerce), as in the highest degree impolitic; though, under that very system, the commerce of Great Britain has risen to a height, altogether unexampled in history. But as our legislature have wisely deemed it expedient, to protect both manufactures and commerce, which, under such a system, have so eminently flourished, no good reason can be assigned, why agriculture ought not, in the like manner, to be encouraged in Great Britain, where it produces such a great revenue;—where, with above 800 millions of national debt, we still have above twenty millions of acres, lying in a state comparatively waste and unproductive;—where the population is rapidly increasing, and where it has been found necessary, for some years past, to import no inconsiderable portion of the means of our subsistence ([12]).

It is certainly better to let agriculture alone, than to establish injudicious regulations respecting it. But if a government will make such inquiries, as may enable it to judge of what can be done with safety and advantage; and will promote agricultural industry, not only by removing every obstacle to improvement, *but by granting positive encouragement*, agriculture will advance with a rapidity, and will be carried on to an extent, which is hardly to be credited; and in a much superior degree, than by the "let alone system," under the torpor of which, ages might pass away, without accomplishing, what might be effected in the course of a few years, under a judicious system of encouraging regulations.

The principal encouragements, which a wise and liberal government will be anxious to bestow upon agriculture, may be classed under the following heads: 1. Removing obstacles to improvement; 2. Relieving agriculture from any burdens peculiarly affecting it; 3. Promoting the collection and diffusion of useful information; 4. Giving a preference to domestic productions in the home market; 5. Encouraging the exportation of any surplus produce that may remain on hand, after the demands at home are supplied; 6. Extending, by every prudent means, the cultivation of waste lands, in order that the productive territory of the country may be constantly on the increase; 7. Granting public aid to substantial improvements, such as roads, bridges, canals, &c. on which the agricultural and general prosperity of a country so essentially depend; and, 8. Countenancing the establishment of public bodies, or corporations, to furnish the means of carrying on such improvements, as are beyond the power of individual wealth or enterprise.

Sect. I.—*On removing Obstacles to Improvement.*

There is no duty more incumbent on the government of a country, or from which more advantage might be derived, than that of ascertaining those obstacles to improvement, which are occasioned by the defectiveness of the laws. In England, property held in common cannot be divided, without the unanimous consent of those having an interest in it; and even the Crown, corporate bodies, and the guardians of minors, cannot consent, unless authorised by a special act of the legislature. Nothing can be more impolitic, than retaining such impediments to improvement. Such legal disabilities to enable private individuals to consent to an inclosure, ought to be removed by a general law, and a division ought to be authorised, if agreed to by a majority in value of the parties interested, and authority given, to appoint commissioners for that purpose. Various attempts have been made, to procure the sanction of Parliament to such regulations, but hitherto unsuccessfully, owing to the influence of those, who feel an interest in preserving the present system, and its abuses. It is full time to give up legislating *in detail,* and to act upon broad principles of general polity ([15]).

Sect. II.—*On relieving Agriculture from Burdens peculiarly affecting it.*

This is a subject that has been already discussed. (See Chapter I. Sect. 9). The exaction of tithes in kind, and heavy assessments for the maintenance of the poor, are felt with peculiar severity by the farmers in England; and if continued on their present footing, must ultimately in a great measure destroy the value of landed property in that part of the kingdom, or at any rate will prevent its improvement. The proper interests of the church cannot be affected, if a fair commutation be given for tithes, payable in corn, instead of persevering in a system, accompanied with so much private vexation and public injury. In regard to the poor-rates, it is on all hands admitted, that some plan must be devised, to alleviate that heavy and still increasing load, which, in many cases, has already become more oppressive, than all the other burdens upon land united.

Sect. III.—*On promoting the Collection and Diffusion of Useful Knowledge.*

It is a saying sanctioned by the authority of Bacon, that "*knowledge is power.*" Of all the various sorts of power, enumerated by that great philosopher, this seems by far the most important. What gives one man any real superiority over another, but the knowledge he possesses? What enables some individuals, to produce abundant harvests,—to carry on a prosperous commerce,—to establish successful manufactures,—to excel in mechanism, or any other useful art, but the acquisition, and judicious application of that knowledge in which others are deficient?

That the power and prosperity of a country depend on the diffusion of useful knowledge, can hardly be questioned; and there is probably no art, in which a variety of knowledge, is of more essential importance, than in that of agriculture. The extent of information necessary to bring it to any thing like perfection, is far greater than is generally supposed. To preserve the fertility of the soil;—to free it from superfluous moisture;—to cultivate it to the greatest advantage;—to raise its productions at the least expense;—to procure the best instruments of husbandry;—to select the stock likely to be the most profitable;—to feed them in the most judicious manner, and to bring them to the most advantageous markets;—to choose the plants best adapted for the soil and climate, and the most likely to become profitable;—to secure the harvest, even in the most unpropitious seasons;—to separate the grain from the straw with economy and success;—and to perform all the other operations of agriculture, in a judicious manner, require an extent, and variety of knowledge, greater than may, at first view, be judged requisite, and indeed greater, than perhaps any other art or science requires ([16]).

But though agricultural knowledge may be diffused over a country, experience teaches that it cannot be usefully improved, unless by comparing the various practices which subsist in different parts of it. One district has been led to pay a peculiar and successful attention to one branch of husbandry, or, by a fortunate accident, some important discovery has been made in it, while other districts excel in other particulars of equal importance. Mutual benefit is derived from the communication of such local practices. Of this, the improved modes of draining by Elkington;—the warping of land on the banks of the Humber;—the drilling of turnips and potatoes in the northern part of the island;—and the more general use of the thrashing-mill, and various other instruments of agricultural machinery, may be cited as examples.

The advantages that may be derived, from the result of inquiries carried on by the Board of Agriculture, in so far as regards the culture of arable land, may thus be briefly stated. 1. The means have been explained, by which, in fertile districts, and in propitious seasons, the farmer may, on an average, confidently expect to reap, from 32 to 40 bushels of wheat; from 42 to 50 bushels of barley; from 52 to 64 bushels of oats; and from 28 to 32 bushels of beans, Winchester measure, per statute acre. 2. In regard to green crops, 30 tons of turnips, 3 tons of clover-hay, and from 8 to 10 tons of potatoes, per statute acre, may be confidently relied on. In favourable seasons indeed, the crops may be still more abundant; but even these average ones, spread over a large proportion of the united kingdom, are sufficient to produce more solid wealth, than can be furnished by the greatest extent of foreign commerce ([17]).

The various means, by which useful information may be collected and diffused, are, 1. Forming institutions for that purpose;—2. Establishing experimental farms;—3. Instituting agricultural professorships;—and, 4. Improving veterinary knowledge.

1. *Institutions for collecting and diffusing Agricultural Information.*—The establishment of a Board of Agriculture in Great Britain, scanty and circumscribed as its means were, while it continued in existence, always produced the happiest effects ([18]), and will probably in future be considered as an era in the history of the art. Notwithstanding the limited powers of that institution, the most distant parts of the country were soon made acquainted with each other's useful practices; and the knowledge of beneficial inventions, which, from the insulated state of farmers, might for centuries have been confined to the place of their origin, were at once rendered generally accessible. The publication of the County Reports in particular, proved of peculiar importance, from the discussions which they occasioned;—the spirit of emulation which they excited;—the knowlege which they were the means of circulating;—the truths which they established;—and the errors which they contributed to overturn ([19]). Animated by the example of that Board, a much greater number of agricultural societies were soon constituted, than had ever before existed in this, or any other country; there being hardly an extensive district in the united kingdom, in which one, and sometimes more of such associations, were not established ([20]). A zeal for the improvement of husbandry, was thus cherished and kept up; and

in the course of friendly and familiar conversation, useful observations were made, new facts were brought to light, and practical knowledge, derived from experience, generally diffused. Much good has already been done by these societies; but still more would have been effected, had the Board of Agriculture been placed on such a footing, that it might have acted as a common centre, to all these numerous associations, and for that purpose, had been invested with the privilege of correspondence postage free. The Board would thus have been enabled, to perform those public services, which were in the contemplation of those, by whose exertions it was originally established ([21]).

2. *Experimental Farms.*—The art of agriculture can never be brought to its highest degree of perfection, or established on rational and unerring principles, unless by means of experiments, accurately tried, properly persevered in, and carefully registered. The ardent inquirer has been too long compelled to rely on vague opinions, and assertions which have not been warranted by sufficient authority; it is full time therefore, by the establishment of experimental farms, under the sanction, and at the expense of government, or by enabling the Board of Agriculture to grant adequate premiums to deserving persons, for new discoveries, to bring the art, to as great perfection as possible, by ascertaining the principles on which it can most profitably be conducted.

It is said, that there are many distinguished characters, who carry on experiments for their own information and amusement, by means of which, every important fact, will in process of time be ascertained ([22]); and it cannot be doubted, that their example is of very great advantage to those, who have the means of examining the progress that is made. Their farms, however, are, more properly speaking, *pattern farms*, for the advantage *of the farmers in their immediate neighbourhood*, than experimental ones, in the strict sense of the word; and they are too often, rather the partial records of successful experiments, than the faithful journals of success and of disappointment. In order to render experimental farms generally useful, they ought to be open to the inspection of the public; the account of each experiment ought to be regularly published, and every new practice, likely to improve the cultivation of any considerable part of the kingdom, ought to be examined with the utmost precision, every trial repeated for confirmation, and, if possible, made by different persons, in different places, and on different soils.

It cannot be expected that persons of high rank, whose attention is necessarily directed to other objects, should renounce their ordinary pursuits, and devote themselves exclusively to the conducting of agricultural experiments: but if one or more experimental farms were established, under a proper system, it would ere long be discovered, what practices ought to be avoided, as well as what ought to be pursued. It is important, that the former should be made known as well as the latter; yet *errors in husbandry* are seldom communicated to the public, or known beyond the sphere of a confined neighbourhood, because a farmer is in general ashamed of acknowledging his want of success. Unfortunately also, when his experiments answer, they are sometimes concealed, lest others should avail themselves of the discovery. The object of an experimental farm, however, should be, to ascertain facts, *and to publish them;* and as much credit would be acquired, by an intelligent conductor of an experimental farm, for his exertions in detecting errors, as in establishing facts likely to be useful ([23]).

It would surely be a highly beneficial measure, for a country possessing such an immense revenue, to lay out any moderate sum that may be necessary, were it only L.5000 per annum, for ten or twenty years, to ascertain points of such essential importance, and which might be the means of making very great additions, to the national produce, revenue and wealth.

3. *Agricultural Professorships.*—It is not many years ago, since, at the expense of a private individual, (the late Sir William Pulteney), a professorship was established at Edinburgh, for reading lectures on the art of agriculture. The utility of such an institution is so evident, that it ought to be extended to all the other universities. By such establishments, the attention of young men, would be directed early to this most useful of all the branches of knowledge, which has now become the general subject of conversation, whereever they go. If they inherit landed property, agriculture is the topic to which their views should be particularly directed. There is scarcely any profession also, which will preclude them from spending some part of their time in the country, which some skill in husbandry, would render more agreeable; and if, after having accumulated a fortune, they become proprietors of land, their having early acquired such knowledge, would be a source of much gratification, and perhaps of profit. For such establishments, no new grant would be necessary, or required from Parliament, but merely

an act, suppressing those professorships, which are at present sinecures, or of little real utility, and establishing in their room, those of agriculture ([24]).

4. *Improvement of Veterinary Knowledge.*—Some encouragement has been given, by an annual grant, to the acquisition and diffusion of veterinary knowledge; a deficiency in which, had proved so fatal to the public interest. It is not improbable, that for every pound of public money that has been in this way laid out, a thousand have been saved in our national expenditure, in the article of horses alone, employed in the cavalry and artillery. It would be desirable, indeed, that schools for veterinary knowledge, should be established in all the principal towns in the kingdom; and that the preservation of every species of our valuable stock of domestic animals, should no longer be left to ignorance or quackery, but that the practice to be adopted, in the management of their disorders, should be grounded on scientific principles.

Sect. V.—*To give a Preference to Domestic Agricultural Productions in the Home Market.*

This is peculiarly necessary, both to preserve the country from famine, and to render it independent of other nations for the necessaries of life. To permit the industry of any foreign nation, to enter into competition with our own domestic industry, or productions, is not allowed in the manufactures of linen or cotton, and many other articles, and ought still less to be suffered in that of corn.

If two nations, similarly circumstanced in regard to soil, climate, labour, and circulation, were to give each other reciprocal liberty of trading, the system, on the whole, might not be materially injurious to either; but to place in competition the industry of one country, which has a great national debt, and heavy taxes, and where the price of labour must consequently be high, with that of an indefinite number of other countries, which, with better climates and more fertile soils, are not subject to the same burdens, would be highly inexpedient. Besides, no country that has sufficient extent of surface, and can by any exertion produce food for itself, would act wisely, to allow itself to be dependent on others for subsistence.

The equitable principle, therefore, is, to impose a protecting duty on all foreign agricultural productions, until their price be at least as high as that at which they can be raised in Britain, in seasons of moderate fertility, and gradually to diminish that duty as prices rise, but still, giving a decided preference, to the produce of the agriculture of the united kingdoms.

The exportation and importation of grain, and other agricultural productions, either duty free, or at low rates, in justness and equity, can only take place between nations, where the value of money is the same, where they are subject to the same weight of taxation, are similarly situated in regard to soil and climate, and live in amity with each other ([25]).

Sect. VI.—*To encourage the Exportation of any Surplus Produce.*

It is likewise highly expedient, to promote the exportation of domestic produce, if there be any redundancy, after supplying the demand at home. It is not sufficient to permit the exportation; but it may be necessary, for the encouragement of domestic cultivation, and in order that the articles grown at home, may be enabled to meet the productions of other countries, in foreign markets, *on equal terms*, to give what is called a bounty on exportation. Nothing, however, can be more erroneous, than to consider that encouragement *a bounty*, when it is in fact *a drawback*, under another name. The farmers at home, are subjected to a variety of taxes, which are not imposed on their foreign competitors. To enable them to meet on equal terms, they are entitled to receive an allowance, on every quarter of grain exported, equal to what they had actually paid on its account to the public, under various denominations. It is but just, that the government should repay the taxes it had received, on what is thus exported, to enable the farmers, under its protection, to enter into a fair competition with foreign cultivation; more especially if the rates at which importation is allowed, are so fixed for the benefit of the manufacturers, that the corn growers can, at no period, obtain great profits, the increased price being, in general, only a bare compensation for deficiency of produce.

SECT. VII.—*To promote the Improvement of Waste or Unproductive Lands.*

IT is of peculiar importance to a country, increasing in population, to be constantly adding to its productive territory. There are different ways by which that object may be promoted : 1. By facilitating the division, drainage, embankment, and improvement of commons, meadows, or other intermixed lands ; at least in all cases where two-thirds, or three-fourths of the parties concerned, are in favour of any such measure; and this benefit might be made attainable, by an act of the legislature, authorising an application to the Quarter Sessions in England, or Sheriffs in Scotland, to order an inspection, and a report of the expense, &c. to be made, and after hearing parties, to decide on the propriety of the application. If then approved of, the direction and execution of the improvement, should be referred to commissioners; 2. By exempting from the payment of tithes and poor-rates, for a term of years, according to the expense of the improvement, waste lands brought into cultivation; and, 3. By fixing the price at which foreign corn should be permitted to be imported free of duty, at such a sum, as will enable a British farmer, to defray the expense of reclaiming waste, or improving uncultivated land. For unless this be done, it is impossible, that the produce of our *barren soils,* cultivated at a great expense, can stand a competition, with the produce of the *fertile fields* of other countries, where the expense of cultivation must, comparatively speaking, be inconsiderable.

Among our *unproductive lands,* a large proportion of those subject to the process *of fallow,* ought to be included. In Scotland, owing to the stubbornness of its clayey soils, and the wetness of its climate, any material diminution cannot at present take place; nor until the soil is rendered much more friable, which it will probably be, in the course of such improved cultivation as these lands now experience. But there are extensive tracts in England, where, instead of a naked fallow, turnips, and other green crops, might now be cultivated with advantage; and by means of which, food might be raised, more than we are now under the necessity of importing from other countries.

Sect. VIII.—*To encourage Permanent and Substantial Improvements.*

The wealth, and agricultural prosperity of a country, materially depend, on the promotion of such great and substantial improvements as, 1. Roads and bridges;—2. Canals;—3. Railways;—4. Harbours;—and, 5. Embankments. Where the aid of government cannot be given to such undertakings, the establishment of corporations, under the sanction of public authority, might be found an advantageous mode of carrying such improvements into effect.

1. *Roads and Bridges.*—As the first means of introducing improvements into a country, roads and bridges are essential; and where the population is thin, and the country is poor, there is no possibility of having such communications made, without public assistance. Two plans for that purpose have been adopted in making roads. By the one, the military have been employed in such public works; by the other, under the authority of commissioners appointed for that special purpose, the public has agreed, in the more remote parts of the country, to advance one-half of the expense of making roads and bridges, where the proprietors come forward with the other. The communications which have been opened, in consequence of this encouragement, are numerous, and the public will soon be amply indemnified, for any sum thus expended, by the increased revenue which will be derived from districts, that have hitherto been unproductive ([26]).

In times of peace also, the military cannot be better employed, than in carrying on public works of so useful a description, as roads, canals, &c. Unless when engaged in war, soldiers are benefited by this active employment, which strengthens their bodies, and occupies their minds. The remains of those roads, which were constructed by the Roman armies, fully prove, what that intelligent nation considered to be the best means of preparing soldiers, in time of peace, for the hardships, and achievements of war.

2. *Canals.*—The advantages of canals to agriculture, need not be dwelt upon. They facilitate the means of conveying the bulky productions of the soil to market, and also of bringing, at a moderate expense, not only coal, but lime, and other manures, to the farmer. Under a proper system also, the surplus water might be usefully employed, for the purposes of irrigation. On all these accounts, canals ought

to be encouraged by the government of the country. It is not desirable, except in very particular cases, that they should be executed at the public expense; but it would greatly promote such useful undertakings, if government were to lend a certain sum to the proprietors of such canals, at a moderate interest, to enable them to complete any undertaking of that sort. This was done for the Forth and Clyde navigation; and the company has since repaid the loan. The same plan might be successfully adopted in other instances; and the principle is at last sanctioned by Parliament, in a recent act, the effects of which, under judicious management, can hardly fail to prove highly beneficial ([27]).

3. *Railways.*—This new mode of conveyance, is capable of being rendered as extensively useful as canals, and is well entitled to the encouragement of government, by loans of money, at a moderate interest, to carry them on. The government of this country, can always borrow money at a cheaper rate than private individuals, from *the speculation* that attends public loans; and the facility with which the monied interest can re-invest their savings in the funds, for the purposes of accumulation, in preference to any other security. Railways would be particularly convenient, where canals are impracticable; and where either may be undertaken, the former, affording communications at all seasons, will often be preferred. They ought to be promoted, because the more that communications can be opened between one part of the kingdom and another, the more does a country prosper, and the more are the people in it combined into one great community. The wonderful success of the railway from Liverpool to Manchester, must soon be the means of extending that beneficial system over the whole kingdom.

The extension of railways and canals, is to be considered of peculiar importance, in another point of view, namely, as tending to diminish the number of horses, the maintenance of which, is the great cause why our agricultural productions, are not adequate to the subsistence of our inhabitants. Let the unemployed poor therefore, be employed in the construction of these useful public works, and we should soon be able, to feed ourselves, by the advantages resulting, through the medium of their labour; for land, now devoted to the production of food for horses, might then be appropriated to the raising of food for man.

4. *Harbours.*—Though harbours are more essential in a commercial, than in an agricultural point of view, yet they

are still of material consequence to the husbandry of a country by facilitating the exportation of bulky articles of produce, and the importation of coal and lime, those essential articles to the farmer. The same plan of public assistance, either in whole, or in part, will be found as useful in regard to harbours, as to railways or canals, and has answered in practice. Certain sums of money, (arising from the forfeited estates in Scotland), which were at the disposal of Parliament, were granted for improving harbours on the north-eastern coast of Scotland. The sums given were trifling; in general from two to four thousand pounds each; and excepting in one instance, where the sum was granted to encourage a fishing establishment, erected by a public-spirited company, (the Society for improving the Sea Coasts of the Kingdom), the inhabitants of the towns or neighbourhood, where that assistance was bestowed, were bound to furnish one-half of the total sum to be expended. The effect of this system has been most beneficial ([28]). It is not so much indeed the sum actually given, *as the spirit which it excites*, that is of service; and when once such a spirit is roused, it is not confined to one object, but extends itself to others. Little causes thus produce great effects; and a moderate public expenditure of a few thousand pounds, may lay the foundation of an extensive fishery, or a great emporium of commerce, and promote, at the same time, the agricultural prosperity of an extensive district.

5. *Embankments.*—When the difficulty and hazard of embanking a considerable tract of country, either against the overflowings of a lake or river, or the inroads of the sea, are considered, there is no undertaking, that seems better entitled to the encouragement of a wise government. Extensive tracts of fertile territory, may thus be acquired, greatly to the public advantage. The soil thereby obtained, is generally of a nature peculiarly productive, and well adapted for agricultural purposes. To carry on such undertakings, however, at the public expense, might be hazardous; but when their utility, and ultimate profit, are sufficiently proved, by the evidence of intelligent engineers, to the conviction of Parliament, it may be advisable for the legislature, in times of peace, to authorise the advancing one-third, or any other proportion of the estimated expense, at a moderate interest.

Where extensive drainages are necessary, the same encouragement ought to be given.

6. *To establish Corporations for carrying on beneficial Im-*

provements.—Many of these improvements might be successfully promoted, *by the establishment of corporations,* for carrying on particular objects, which cannot be effected by individual wealth [29]. This is frequently done in the case of canals, and the practice ought to be extended to other useful objects. The formation of such associations, is at present the more expedient, that there is likely to be a large capital, requiring profitable employment, much of which will be sent abroad, unless it can be laid out at home to advantage. Much good therefore might be effected, by erecting public companies, for specific objects of improvement;—for employing the poor in agriculture;—or for lending money to all such landed proprietors, as had any great improvement to execute; the sum advanced, never to be demandable, but the stock of the company to be transferable, like other public securities, which would answer equally well the purposes of those stockholders, who might wish to receive again the sums which they had subscribed. *Estates under the fetters of strict entail, might thus be improved, which otherwise would be neglected.* The surplus capital of the country would thus be employed at home, *and embodied,* it may be said, with our own territory; and the whole country would be improved in a manner, and to an extent, that cannot otherwise be attainable.

It was by promoting such measures as these, that the most celebrated statesman of modern times, justly called Frederick the Great, (more from his attention to internal improvement, than to foreign conquests), raised his dominions, notwithstanding the disadvantages of situation, soil, and climate, to that height of prosperity and power, to which they attained during his reign [30]. His practice was, to lay out about L.300,000 sterling *per annum,* in the encouragement of agricultural improvements, which he considered, "as manure spread upon the ground," to secure an abundant harvest; and in fact, instead of being impoverished by such liberal grants, he thereby increased his revenues so much, that he was enabled to leave a treasure behind him, amounting to above L.12,000,000 sterling [31]. On the other hand, this country, owing partly to unfavourable seasons, partly to its increased population, and in no small degree, to its agricultural interest not being sufficiently encouraged [32], has been under the fatal necessity, of transmitting to other nations, above 57 millions sterling, in the space of twenty years, and no less a sum than twelve millions, *in one year*, to procure food for its inhabitants!

The celebrated Watson, Bishop of Llandaff, has most ably explained the advantages to be derived by agriculture, from such public encouragement, in the following words: "The agricultural improvements which have hitherto taken place amongst us, have been by the expenditure of private wealth; but the country cannot be brought *to that perfection of cultivation*, of which it is capable, unless individual efforts, are aided and accelerated, *by public wisdom and munificence.* I boast not of any particular patriotism, but I would willingly pay my share of twenty or thirty millions of public money, to be appropriated by the legislature, to the agricultural improvement of Great Britain and Ireland. This appears to me, to be an object, of far nearer concern to our independence as a nation ([33]), than any extension of commerce, or any acquisition of distant territory ever can be. If the time had fully come, when an unproductive acre of land could not be found in either of these, our *fortunate islands*, we shall then have food within ourselves, for the annual sustenance, of at least thirty millions of people; and with a population of thirty millions, what power in Europe, or what combination of powers, will dare to attempt our subjugation ([34])?"

May these considerations be listened to by those, who take an active part, in conducting the government of this great empire; and may some effectual steps be taken, by encouraging cultivation and improvement, in the manner above suggested, or by such other means as may be judged most useful, not only to prevent, what is justly accounted the greatest of all possible calamities, scarcity or famine, but also to promote the future permanent welfare and happiness of the people!

JOHN SINCLAIR,
In the 79th year of his age.

133. George Street,
Edinburgh,
1st October 1832.

NOTES

REFERRING TO

THE AUTHORS QUOTED IN THE CODE OF AGRICULTURE.

CHAPTER I.

1 Agriculture, even restricted to the management of farm lands, when viewed in all its branches, and treated of to its full extent, is not only the most important, but the most difficult to explain, in the whole circle of human arts and sciences.—*Marshall's Rural Economy of the West of England*, vol. i. p. 56.—*Dr Coventry's Discourses*, p. 23.

2 Climate and soil, as Mr Curwen justly remarks, are, *above all other considerations*, those which the farmer ought constantly to keep in view.—*Report to the Workington Society*, p. 36.—He adds, " that some practices, which completely answer in a better climate, I have found to fail most lamentably on my own farm." The importance of climate, indeed, is generally admitted; yet, in carrying on their agricultural enterprizes, many proprietors are too apt to forget it. Hence, after they have improved their land at a great expense, their hopes of success are frequently disappointed, by the want of a thorough knowledge of the climate on which they have bestowed their money and exertions.

3 Derbyshire Report, vol. ii. p. 268; vol. iii. p. 671.

4 Kincardineshire Report, p. 17; Derbyshire Report, vol. ii. p. 259.

5 Middlesex Report, p. 16.

6 Communication from John Middleton, Esq.

7 Wakefield's Account of Ireland, vol. i. p. 166.

8 Robertson's History of the Atmosphere, vol. i. p. 170. Ovid takes notice of the freezing of the Euxine during winter, and it would appear, *that it was sometimes covered with ice, even in summer.* Ibid. p. 16.—This latter degree of coldness, however, has long been unknown in those parts, since they were cleared of woods. It appears from Horace, that about the year 480 from the foundation of Rome, the Tiber was frequently frozen over, and the ground was often covered with snow, during the space of forty days at a time. Polybius describes the climate of Gaul and Germany, as a perpetual winter. The climate of North America has been greatly improved, since it has been cultivated. See Transactions of the American Philosophical Society, vol. i.

9 Heat has also an effect on animal matter. It has been remarked by an eminent chiropodist, that the nails both of the fingers and toes, but particularly of the former, grow much more in summer than in winter.

10 It is known, that water below 40° of heat, expands, in its progress to congelation, to 32°, and as much as to 48° of heat upwards, when it is becoming

warmer. In the progress down to congelation, no vegetation can be carried on, as the water in plants, chills them in that state, and when below 32°, often kills them altogether.

11 Mr Ker, an eminent brewer at Peebles, in Scotland, found, that English barley, on an average, yields fully one-fifth more of fermentable substance, from the same weight of grain, than Scotch barley.—*Peeblesshire Report*, p. 7, note.

12 Ross-shire Report, p. 33.

13 Humboldt found some plants growing in the galleries of mines, which retained their natural green appearance, though kept in places completely dark. But this was owing to the uncombined hydrogen gas, which abounded there. See Robertson's Natural History of the Atmosphere, vol. ii. p. 190. The plants called *esquisetum*, found anno 1812, in the cast-iron pipes which supplied Edinburgh with water, were likewise green.—*Communication from John Farey, Esq.*

14 General View of Vegetable Nature, by Mr C. F. Brisseau Mirbell, printed anno 1815, published in the Quarterly Journal of Science and the Arts, printed by the Royal Institution, No. III. p. 48, where Mirbell's work is with justice stated to be, the best lecture, on the subject of vegetation, that has hitherto appeared.

15 Kent Report, p. 250. Hence the importance of destroying weeds, by whose roots so much valuable moisture is absorbed, (more especially in light soils), and taken from the nourishment of the crop sown or planted.

16 General Report of Scotland, vol. iv. p. 136.

17 Statistical Account of Scotland, vol. xix. p. 249. In such latter case, there is often a quick vegetation in the shocks of the grain after it is cut down, or it heats in the stacks when carried into the barn-yard; and drizzling rains, during warm weather, when a crop of wheat is approaching to ripeness, are almost certain to mildew it.

18 Survey of the Norman Islands, by Thomas Quayle, Esq. p. 242.

19 The German Ocean is above three degrees colder in winter, and five degrees warmer in summer, than the Atlantic. From that greater warmth, a copious evaporation takes place, which produces those thick mists (or *haars*, as they are called), which arise from the sea, and advancing upon the land, occasion colds and other disorders.—*General Report of Scotland*, vol. i. p. 42.

20 Ross-shire Report, p. 3.

21 Forfarshire Report, p. 75.

22 See the Tables in the East Riding Report, p. 10.

23 Cornwall Report, p. 4.—"When the wind is impregnated with saline particles occasioned by the west and south-west winds beating the salt water against the beach, all the hedges and trees on the windward side are destroyed, and generally speaking, the foliage wears the aspect of its wintery dress."—*Sussex Report*, p. 3.

24 Lancashire Report, p. 2.

25 Williams on the Climate of Great Britain, p. 2. and 3.

26 Autumnal frosts creep along the beds of rivers, destroying the corn in the flowering season, and blasting the stems of potatoes in low situations. Winter frosts are ultimately rather favourable to vegetation; as snow is, particularly when it covers the ground for some time, and gradually melts away. It has been remarked, that frosts and great falls of snow have a sedative effect upon the atmosphere.

27 Thus the eruptions of a volcano may prevent the more fatal shocks of an earthquake.—See *Woodward's Essay*, p. 3. § 14.

28 Young's Travels in France, vol i. p. 313. At the same time, it is an undoubted fact, that in Dumbartonshire, rocks nearly bare of earth, and almost perpendicular, under oak coppice, have brought, by the sale of wood and bark, a price equal to an annual rent of from 18*s*. to 20*s*. per English acre. General Report of Scotland, vol. ii. p. 248; Stirlingshire Report, p. 212; Dumbartonshire Report, p. 156; and Derbyshire Report, vol. ii. p. 225.

29 In France, meadows are higher rented, and pay heavier taxes, than vine-

yards; and it was well observed by an English sailor, when a Spaniard taunted him with a display of oranges, which his country produced, he said, *twice a-year,*—"See," (says he, holding up a great Cheshire cheese), "what my country produces *twice a-day.*"

30 Derbyshire Report, vol. ii. p. 114. 31 Ibid.

32 Husbandry of Scotland, vol. i. p. 151.

33 Statistical Account of Scotland, vol. iv. p. 565.

34 Young's Annals of Agriculture, vol. xxxix. p. 487.

35 Dr Graham very justly remarks, that in a variable climate, every farmer should be somewhat versed in the prognostics of the weather. Long experience has given rise to a set of maxims on this subject, which are not unworthy of the attention of the physiologist, while they are the common guides even of the most illiterate.—*Stirlingshire Report,* p. 12.

36 The weight of the atmosphere is subject to frequent variations, and the change of its density is made use of, to prognosticate the weather, by means of an instrument called the barometer. During the prevalence of easterly winds, from some unknown cause, (perhaps their greater dryness), the indications of the barometer, are not so much to be relied on, on the eastern coast of Great Britain. Nor is this instrument so useful in variable weather, as when a great change is to take place; and in the winter season, it is of little avail.—*Derbyshire Report,* vol. i. p. 98. But, on the whole, the barometer furnishes the best indications of the state of the weather, of any instrument we have. At Chatsworth, since 1763, the daily quantity of rain has been carefully registered, and some curious deductions therefrom will be found in the Derbyshire Report, vol. i. p. 99.

37 The hygrometer is made with sponges, or other materials, affected by dampness in the air, for ascertaining the degree of moisture at any particular time.

38 Derbyshire Report, vol. ii. p. 126.—Dr Graham, of Aberfoyle, in his paper on climate (General Report of Scotland, vol. iv. p. 146, note), very justly remarks, how much it is to be regretted, that scarcely any of our Scottish naturalists, have thought of recording, from year to year, the *vernation,* or *foliation* of our indigenous plants. Such a register would furnish the best criterion of climate, that could possibly be conceived; and by comparing the differences of vernation in the course of a number of years, we might be enabled to make an approximation, which no other data could afford us. In the Dorset Report, p. 34, there are same valuable remarks upon the same subject.

39 Dr Coventry's Discourses on Agriculture, printed an. 1808, p. 29.—If it were possible, to ascertain the courses of the seasons, for a considerable number of years, it might probably lead to some discovery, whether there be any fixed law of nature, by which the revolutions of good and bad seasons are brought about.—*Clydesdale Report,* p. 10.

40 Sir Humphry Davy's Lectures on Agriculture, p. 11.

41 Stirlingshire Report, p. 23.

42 Forfarshire Report, p. 55. It has been found, that according to Fahrenheit the heat of the ground is commonly 2° or 3° higher than that of the ambient air in warm weather, and considerably more in cold weather.

43 Inverness-shire Report, p. 12.

44 *La première richesse d'un peuple est son sol, et son ciel.* This maxim, however, is more applicable to southern than to northern countries, for in the latter, *good culture* is essential, even with a good soil, whereas in the former, as in the East Indies, the soil is so very rich, that every thing vegetates without art, and the necessity of invention, or great labour, does not exist.

45 Sir Humphry Davy's Lectures, p. 163. And in this point of view, Mr William Smith's large Map of the *Strata* of England, and the Memoir accompanying it, are particularly valuable. Also Mr John Farey's more minute, but local observations of the strata and soils of Derbyshire.—*Report,* vol. i. p. 303, &c. &c.

46 One of the most intelligent farmers in Norfolk, accustomed to a dry and sandy soil, was asked, What he would do with a wet or clayey one? He very

candidly answered, " That he knew no more how to manage such a soil, than if " he had never seen a plough." Farmers, when they change their situations, are too apt to carry along with them, that plan of management to which they have been accustomed, without considering that it may not suit their new situations.

47 Statist. Account of Scotland, vol. iii. p. 468.

48 It is well observed by Dr Coventry, (Discourses, p. 83), that in describing and classing soils, the divisions should be simple and obvious, and should have utility and practice in view, and not nice discriminations. Marshall has divided soils into *fifteen* different kinds; but this number is too great, and can only tend to confuse the reader.

49 Where the soil is a mere blowing sand, the great object is, to prevent its doing mischief, by what are called, " *sand-floods*," or, " *sand-drifts*." This can only be done, by propagating maram, or sea-bent, (*Arundo arenaria*), and other plants, which will grow in such soils, and will tend to fix them. This point is particularly attended to, by the inhabitants on the shores of the German Ocean.—*Coventry's Discourses on Agriculture*, p. 116. It has of late been much practised in Flintshire, &c. On this subject see Sir J. E. Smith's Travels on the Continent.

50 Fife Report, p. 29.

51 The fuller's earth, sandy, stratum of Surrey, Kent, Berks, Bedford, and other counties, is covered by a black-blue clayey marl, resting upon aluminous clay; one or other of these tenacious strata, may very frequently be obtained; and either of them applied liberally to the sandy soil, will cure its defects.

52 Curwen's Report, p. 14.

53 Brown's Treatise on Rural Affairs, vol. i. p. 83.

54 Sir Humphry Davy's Lectures, p. 178. On his recommendation, Sir R. W. Vaughan of Nannau, in Merionethshire, tried peat on a sandy soil, with much success.

55 Marshall's Norfolk, vol. i. p. 370; and vol. ii. p. 139. Minute 79.

56 Young's Calendar, p. 476. Communication from Edward Burroughs, Esq.

57 The best method of raising wheat on sandy lands, is on a clover ley, when the soil has got an artificial solidity of body, and is thereby rendered capable of sustaining this grain till it arrives at maturity. This is particularly to be recommended, when the turnips have been eaten on the ground by sheep. Dibbling the seed, in the centre of the flag, is, in such cases, an excellent practice.

58 Suffolk Report, p. 125. 59 Young's Calendar, p. 123.

60 See Mr Arthur Young's Lecture on the Husbandry of Three Celebrated Farmers, (Bakewell, Arbuthnot, and Duckett), printed an. 1811, p. 29.

61 Hints on the Agricultural State of the Netherlands, printed an. 1815, p. 10 and 76. Besides carrots, the Flemish farmers sow turnips after the crop is reaped, slightly ploughing the land for that purpose; also spurry, for feeding milch cows, by which excellent butter is obtained; and with their oats, they sometimes sow trefoil, or yellow clover, and get one good cutting of that crop, before it is necessary to plough the land.

62 See Improved Agriculture, and a Sketch of the Flemish System, by F. Vanderstraeten, Supplement, p. 25, printed by Longman and Co. an. 1816; and Hints on the Agricultural State of the Netherlands, p. 71. Radcliff's Agriculture of Flanders, p. 39 and 49.

63 Statistical Account of Scotland, vol. vii. p. 142. A proprietor who had carried the stones off a field by way of experiment, found that it obstinately refused to yield its usual crop, and thus discovering his error, was glad to restore what he had injudiciously taken away. Ditto.—See also Young's Norfolk, p. 11.

64 Remark by Edward Burroughs, Esq. This rule of preserving stones, is by some extended beyond sandy soils, more especially in hot climates. Even in this country, stones are said to be of use in promoting the depth of thin soils; in rendering the texture of clays less compact, and less apt to

subside; and where the soils are *puffy*, in collecting the shifting looseness of the materials.

65 Notes on the Soils of Cornwall, by John A. Paris, M. D. Printed an. 1818.

66 Brown's Treatise on Rural Affairs, vol. i. p. 83; General Report of Scotland, vol. i. p. 53. Breaking the stones of a gravelly soil by machinery, where the stones are soft, has likewise been recommended, more especially if the stones are round; in which state, they do not easily imbibe water, and they readily part with moisture, which does not adhere to a smooth surface.

67 Sir H. Davy's Lectures, p. 162.

68 Kent Report, p. 15; Kincardineshire Report, p. 31. In Cornwall, (see Report, p. 11), Mr James, of St Agnes, cleared a small paddock of the quartz in it, at the expense of about £.40 per acre, and the experiment, on the whole, is said to have answered, by the sale of the stones, and the improvement of the soil.

69 Statistical Account of Scotland, vol. iii. p. 325.

70 See Mr William Smith's Memoir on the Strata of England; and Rudge's Gloucestershire p. 15.

71 Dumbartonshire Report, p. 7.

72 Berkshire Report, p. 19.

73 Kent Report, p. 17.

74 Communications to the Board of Agriculture, vol. iii. p. 255.

75 Cornwall Report, p. 9.

76 Hertfordshire Report, p. 12.

77 Brown's Treatise on Rural Affairs, vol. i. p. 81.

78 Derbyshire Report, p. 303.

79 An eminent agriculturist, J. C. Curwen, Esq. of Workington-Hall, in Cumberland, raised both turnips and potatoes on a clayey soil; but he spared no pains or expense in their cultivation. They were grown in drills, the ploughing was deep, and the manure abundant. In some parts of England, cabbages also are grown on clayey soils.

80 The Swedish turnips have this great advantage, that they can be transplanted, and consequently the ground can be previously well worked. Thus also, they can be raised earlier, and sooner taken off; or they may be raised and stacked in damp weather, and carried off when the frost sets in.

81 Remark by Mr Middleton; Derbyshire Report, vol. ii. p. 190.

82 Cheshire Report, p. 170.

83 See Husbandry of Scotland, 2d edit. vol. i. p. 229. This is the common husbandry on the strong lands of Suffolk. Ditto, vol. ii. Appendix, p. 66. In Ireland, oats thus sown on a retentive clay, will be a fortnight earlier than when sown on a spring ploughing. Comm. from the Rev. Thomas Radcliffe.

84 Middlesex Report, p. 20.

85 Marshall's Kent, vol. i. p. 30.

86 Brown's Treatise on Rural Affairs, vol. i. p. 81 and 100; Husbandry of Scotland, vol. i. p. 239, where the subject of fallowing is discussed at large. Derbyshire Report, vol. ii. p. 102. Dr Coventry contends, "that there are certain soils and situations, where summer-fallowing cannot be advantageously relinquished, for any other process of tillage whatsoever."—*Discourses on Agriculture*, p. 70. See also the Staffordshire Report, p. 50, where the practice of fallowing strong lands is ably defended.

87 General Report of Scotland, vol. ii. p. 389; Derbyshire Report, vol. ii. p. 396.

88 Leicestershire Report, p. 3.

89 See "Essay on the Management of Fen Land," by John Wing, Esq. of Thorney Abbey, late agent to the Duke of Bedford. Nothing could be more advisable than to introduce the fen husbandry, described in that work, into the peat-bogs of Ireland and Scotland.

90 Dumbartonshire Report, p. 331. See also, Hints on the Agricultural State of the Netherlands, Appendix, No. 7, p. 18. This seems to be a most extraordinary circumstance, but the facts stated in the text are undoubted.

The rotting of the second crop, evidently operates as a manure to the succeeding one.

91 Communication from John Middleton, Esq. Clay, occasionally fit for the potteries, as well as pipes, and fire bricks, though more generally only fit for other bricks and tiles, is frequently met with incumbent on chalk, and may be used as manure to it, with much advantage.—*Ditto.*

92 See Dr Pearson's Essay on the subject, Communications to the Board of Agriculture, vol. iv. p. 321.

93 Communications to the Board of Agriculture, vol. iii. p. 112.

94 Davis of Longleat's Essay. See Communications to the Board of Agriculture, vol. iii. p. 85.

95 Mr Boys of Betshanger's Essay. Communications to the Board of Agriculture, vol. iii. p. 257. Paring and burning a thin chalky soil, however strange it may seem, is justified by experience. A considerable covering of coarse worthless herbage and moss, accumulates by time, which is thus got rid of, and produces fertility.

96 It is only necessary to use the black subsoil of the chalk stratum, as a manure to this soil, in order to secure abundant crops of corn or grass. Communication from John Middleton, Esq.

97 Clydesdale Report, p. 23; Northamptonshire Report, p. 10; Derbyshire Report, vol. ii. p. 176.

98 Kames's Gentleman Farmer, p. 323.

99 Kirwan on Manures; Transactions of the Irish Academy, vol. v. p. 135. The sand which loam contains, *is as fine as meal*, in the proportion of 87 of sand, to 13 of clay. See Kirwan's Elements of Mineralogy, vol. i. p. 324.

100 Ayrshire Report, p. 28, 29; Inverness-shire Report, p. 9; Kincardineshire Report, p. 28. In the valuable Report of Middlesex, p. 20, the same observation is made. Mr Middleton there remarks, that a perfect sand, clean gravel, or pure clay, is not now, perhaps, to be found in any part of the county. By the operation of the elements, by manure and cultivation, the surface of all the lands of the county has assumed, more or less, the appearance of loam.

101 Some Authors make a distinction between "*sandy loams*," in which the loam predominates, and "*loamy sands*," in which sand most prevails; the former are best calculated for pasturing large stock; the latter for sheep pasture.

102 Young's Calendar, p. 475; Young's Norfolk, p. 4.

103 Young's Calendar, p. 475. 104 Cheshire Report, p. 170.

105 The conversion of permanent pastures, to crops of lucern, where the soil and climate are favourable, cannot be too strongly recommended.

106 Sir Humphry Davy's Essay. Communications to the Board of Agriculture, vol. iv. p. 314.

107 Stirlingshire Report, p. 23. This may, in a great measure, be effected by deep ploughing and good cultivation.—*Remark by Edward Burroughs, Esq.*

108 Kirwan's Elements of Mineralogy, vol. i. p. 324.

109 Communications to the Board of Agriculture, vol. iii. p. 117, note.

110 Hints on the Agricultural State of the Netherlands, p. 72; Derbyshire Report, vol. ii. p. 268.

111 Sir Humphry Davy's Lectures, p. 56.

112 Young's Calendar, p. 474.

113 Curwen's Report, p. 16.

114 Hence the risk of impoverishing the soil, by the cultivation of potatoes, to be sold off the farm, unless where town manure can be purchased.

115 Sir Humphry Davy's Lectures, p. 178.

116 The roots of wheat penetrate very deep, if the soil is porous.

117 On this important subject, see Mr William Smith's Memoir, and Map of the Strata before referred to.

118 Thus a peaty soil is improved, when properly blended with a clayey subsoil, either by ploughing or trenching.—*Remark by Edward Burroughs, Esq.*

119 See Brown's Treatise on Rural Affairs, vol. i. p. 77; and Dr Coven-

try's Discourses on Agriculture, p. 34. Marshall is considered to be the most correct writer we have on the subject of subsoil.

120 Or "ferruginous schistus." In Ireland, this description of soil is called "*lackleagh.*" It is there considered to be the most effectual mode of improvement, to break through the retentive stratum, by a plough of an immense size and weight, called the *miner,* without a mould-board, drawn by eight oxen, followed, in the furrow formed by a four-horse plough. This substance, once severed, never re-unites.—*Communication from the Rev. Thomas Radcliffe.*

121 Clydesdale Report, p. 9, and 32; Dumfriesshire Report, p. 18.

122 Sir H. Davy's Lectures, p. 162.

123 General Report of Scotland, vol. i. p. 61.

124 Northamptonshire Report, p. 13.

125 General Report of Scotland, vol. i. p. 60.

126 Williams on Climate, p. 227.—It has however, been asserted, that though *steeping* accelerates germination, it produces weaker plants; and that the same end may be attained by early sowing, or putting the seed in with the drills, by which it is properly covered, and moisture is secured.

127 General Report of Scotland, vol. i. p. 60.

128 General Report of Scotland, vol. v. p. 63; and Dr Paris's Notes on the Soil of Cornwall, p. 6.

129 Clydesdale Report, p. 32. This remark is not applicable to tropical regions.

130 Worcestershire Report, p. 4. This calculation does not apply to other countries; and in fact the degree of heat depends, not only upon latitude, but upon the position of the land, whether horizontal, or lying to the south or north; also upon the angle at which the land is elevated, on either of these directions.

131 Mid-Lothian Report, p. 24. See also Northamptonshire Report, p. 8.

132 Argyllshire Report, p. 8.

133 General Report of Scotland, vol. iv. p. 130.

134 North Riding Report, p. 4. Derbyshire Report, vol. ii. p. 114.

135 East Riding Report, p. 3.

136 Communication from the Rev. Thomas Radcliffe. This is an important hint to persons residing in mountainous districts.

137 See Aberdeenshire Report, p. 52; Ross-shire Report, p. 37; Mid-Lothian Report, p. 23.

138 Marshall's General View of the Agriculture of the Central Highlands of Scotland, p. 13; Aberdeenshire Report, p. 52. See also Dr Home on Vegetation.

139 Kincardineshire Report, p. 17; Dumfriesshire, p. 13; Forfarshire, p. 75; and Staffordshire, p. 10.

140 The advantages of vicinity to water, shall be afterwards discussed. See Part II. Sect. 8.

141 Husbandry of Scotland, vol. ii. p. 132.

142 Annals of Agriculture, vol. xxxix. p. 518. Herts Report, p. 29; Surrey Report, p. 113; Middlesex Report, p. 98.

143 Husbandry of Scotland, vol. i. p. 107. This is the practice in the Lothians, where the culture of arable land is carried to much perfection. At the same time, it is the quality of the soil that principally induces a preference to tillage over grazing.

144 Mémoire sur les Besoins, et les Ressources de l'Agriculture Française, par M. le Comte François de Neufchateau. A Paris, anno 1816.

145 Husbandry of Scotland, vol. i. p. 203.

146 General Report of Scotland, vol. iii. p. 268, where the subject of fuel is treated of more fully.

147 Aberdeenshire Report, p. 531.

148 Wherever coal can be had, the consumption of wood diminishes. Essex Report, vol. ii. p. 381; Suffolk Report, p. 204; Derbyshire Report, vol. iii.

p. 196. In America, every fire-place requires at least ten acres.—*Madison's Address, American Farmer,* Sept. 3. 1819.

149 Where estates are very small, it is impossible that many farms can be large; for a great number of proprietors would never agree to let small portions of their little properties to the same farmer.

150 Dr Rigby's Report, p. 92.

151 Statistical Account of Scotland, vol. v. p. 422.

152 Somerset Report, p. 84. It is said that a dairy farm should not exceed 50 cows, which is as many as one family can well manage.

153 It would be well worth while for the dairy farmers in England, Scotland, and Ireland, to visit the Flemish and Dutch dairies, where they might derive many useful hints, regarding the most advantageous management of that branch of husbandry. In the Harleyan dairy system, there is a good account of the Dutch dairies, p. 162.

154 Ayrshire Report, p. 430.

155 Husbandry of Scotland, vol. ii. p. 126.

156 Brown's Treatise on Rural Affairs, vol. i. p. 141.

157 See the Appendix, No. I.

158 Husbandry of Scotland, vol. ii. p. 164; General Report of Scotland, vol. i. p. 182.

159 Sir William Strickland's Observations on the United States of America, in the Communications to the Board of Agriculture, vol. ii. p. 154, 155.

160 General Report of Scotland, vol. p. i. 176.

161 The Rev. Dr Cartwright recollects a curious circumstance of a person who resided, about fifty years ago, in a village on the road between Newark upon Trent and Sleaford, who having been obliged to sell his estate, took it on lease, and made as a farmer, so much money, that he was able to re-purchase it. Small proprietors in general, are seldom possessed of capital sufficient to improve their lands, and frequently indulge notions, which disqualify them from the pursuits of industry. *Dumbartonshire Report,* p. 20.—Hence, in the progress of society, this class of men gradually disappear. *Stirlingshire Report,* p. 69.—The fact is, that it is found more profitable, to have a capital in money, judiciously employed in farming, than a capital in land. A man is more likely to thrive, and to be a useful member of society, who is the possessor of a moderate fortune in money, which he can employ in farming or in any other occupation, than even a greater amount or value in land, which he may find it difficult to stock, or to manage, and which may prevent him from engaging in other occupations, from which he might derive more advantage.

162 Staffordshire Report, p. 30; Ayrshire Report, p. 77.

163 General Report of Scotland, vol. i. p. 172; Husbandry of Scotland, vol. ii. p. 139.

164 Cicero, in his Cato Major, has well observed, "That there cannot be a richer, or a more ornamental object, than a well-cultivated field. *Agro bene culto, nil potest esse, nec usu uberius, nec specie ornatius.*"

165 Dr Coventry's Discourses, p. 55.

166 General Report of Scotland, vol. i. p. 172; Dr Coventry's Discourses, p. 59; Kent Report, p. 50.

167 Gloucestershire Report, p. 34.

168 Among these, the Duke of Bedford, the Earl of Egremont, Lord Somerville, Sir Joseph Banks, Mr Coke in Norfolk, Mr Western in Essex, Mr Curwen in Cumberland, Sir W. W. Wynne, and Sir Robert W. Vaughan in Wales, and others might be enumerated.

This has likewise been much the case in Ireland, where, of late years, the landed proprietors have become agriculturists, either through necessity, (not having been able to dispose of their lands to advantage), or from having caught the patriotic spirit of improvement, so laudably set by the sister kingdom. This has been attended with many beneficial consequences to that country. Gentlemen, instead of devoting their time only to pleasure and amusement, as was formerly the case, are now proud of being considered zealous improvers of their own estates, and do not consider a knowledge of rural affairs derogatory to their condition in life.—*Remark by Edward Burroughs, Esq.*

169 Husbandry of Scotland, vol. ii. p. 140. Formerly a nobleman, who directed his attention to experiments in cultivating the various useful tribes of the vegetable kingdom, was considered by his brother peers as degrading his high station in life. But now, what a change! Every where proprietors are to be met with, who, by every means in their power, either by precept, by example of improved culture, by publications, or by premiums, combat the prejudices of their uninformed tenantry, and become a blessing to their neighbourhood.—*South Wales Report*, vol. i. p. 178. In Ireland also, many of the nobility and gentry have become intelligent farmers; but as they seldom attend to the practical part of it, they often find it difficult to prevail upon their stewards to follow any new system. It frequently happens, that a failure in this case, either through ignorance or obstinacy, prevents a repetition of the intended improvement.—*Remark by Edward Burroughs, Esq.*

170 Cornish Report, p. 17.

171 Some are of opinion, that instead of this kind of experimental farming, it would be of more advantage, both to the proprietor and to the district, to encourage a farmer from another county to set the example, as farmers are, in general, more ready to imitate the practice of their equals than that of a large proprietor, who is so far removed from their own station in society, and, as they observe, who pays no rent for his land.—*General Report of Scotland*, vol. i. p. 172.

172 In Scotland, this plan has been frequently adopted, and with much success. The exertions of an Earl of Findlater, of a Craik of Arbigland, of a Robert Barclay of Ury, of a Henry Home Lord Kames, stand eminently conspicuous in that honourable list.

173 General Report of Scotland, vol. i. p. 173.

174 Marshall on Landed Property, p. 224.

175 See Aiton's Survey of Ayrshire, p. 175.

176 See the Foreign Quarterly Review by Treutell, No. 8, August 1829, p. 484. On the letting of land, or the Metayer system, in Dombasle's *Annales Agricoles de Roville*, 1824-1828, 4 vols. 8vo, Paris. Lewis's Translation of Boech's works, on the Public Economy of Athens, vol. ii. p. 15.

177 Sussex Report, p. 43.

178 General Report of Scotland, vol. i. p. 187.

179 The propriety of varying, to a certain extent, the payments in money, according to the price of grain, shall be discussed in the succeeding section.

180 General Report of Scotland, vol. i. p. 194; also Dumbartonshire Report, p. 48, 49, &c. In imposing such payments and services on his tenants, a landlord in fact buys the worst poultry, at the highest price, and pays for a little work, imperfectly executed, more than would have hired the best workmen to accomplish the same labour; while the improvement of his lands is retarded, and the progressive rise of his rents is checked. P. 45.

181 Annals of Agriculture, vol. xxiii. p. 338. Mr Young here justly questions the good sense and understanding of those landlords, who argue against rich tenants;—who are jealous of seeing a farmer on a good horse;—and think it presumption in him to drink a bottle of wine. In other words, it is saying, that it is better to receive only 12s. than 20s. of rent, per acre.

182 Communication from John Middleton, Esq.

183 It is an old remark, that every arable farm ought to produce three rents; one for the landlord, one for the expense of management, and one for the farmer; to which a fourth ought now to be added, for taxes, and parochial assessments.

184 The use of two-horse ploughs, and the invention of the thrashing-mill, by augmenting the disposable produce, have greatly augmented the rents in Scotland.

185 Husbandry of Scotland, vol. ii. Appendix, p. 173. In Chapter V. shall

be given very important estimates of the amount of disposable surplus, on a clay land, and a turnip-soiled farm.

186 Dr Coventry has drawn up "Estimates of the Produce and Rent of Arable Lands," varying according to the fertility of the soil, and on the climate or height of situation; with some explanatory observations, which are well entitled to the attention of proprietors, and their stewards, on the one hand, and the occupiers of the soil on the other.

187 The nature of these deductions, from the actual produce, will be specified in a paper, written by John Middleton, Esq., which will be inserted in the Appendix, No. I.

188 Communication from John Middleton, Esq.

189 Husbandry of Scotland, vol. ii. p. 201.

190 Worcestershire Report, p. 41. 191 Berwickshire Report, p. 143.

192 In Bedfordshire, (Report, p. 152,) 10 per cent.; in Bucks, (Report, p. 97,) 10 per cent.; in Berks, (Report, p. 114,) 10 per cent.; in Sussex, (Report, p. 45,) 10 per cent.; in Caithness, (Report, p. 49,) 10 per cent.; in Kent, (Report, p. 49,) 11 per cent.; in Dumbartonshire, (Report, p. 68,) $11\frac{2}{3}$ per cent.; in Lincolnshire, (Report, p. 47,) 12 per cent.; in Essex, (Report, vol. i. p. 106,) 15 per cent. The profits of farming are not so much as are usual with manufacturers and traders, who often benefit from new inventions, Derbyshire Report, vol. ii. p. 40. Farming profits are sometimes increased by a large cultivation of some rare plant. Ditto. But on the whole, it appears, that the British cultivator is but poorly compensated for the capital he sinks, and for the labour he undertakes. With such unfavourable prospects, when this most useful class of the community can, with difficulty, obtain a livelihood by their exertions, it cannot be expected, that the agricultural interests of the nation will advance, more especially when there are to be added, the risk of unpropitious seasons, and an inundation of foreign corn.—*Remark by Edward Burroughs, Esq.*

193 Cheshire Report, p. 12.

194 Husbandry of Scotland, vol. ii. Appendix, p. 172; Derbyshire Report, vol. iii. p. 631, note.

195 Shropshire Report, p. 128.

196 Malthus's Inquiry into the Nature and Causes of Rent, p. 58. Yet many have begun farming with a small capital, who being frugal and industrious, have turned out excellent farmers, and have even acquired wealth.

197 Dumbartonshire Report, p. 43. He should also ascertain if there are any local burdens or *servitudes* upon the farm, as a right of common, after the corn is harvested; a privilege of cutting down wood, &c. Such burdens render a farm less valuable. The vicinity of a rabbit-warren;—of landowners over-anxious about their game;—or the neighbourhood of hunts, or coursing clubs, are all deductions from *the rentable value* of a farm.—*Derbyshire Report*, vol. iii. p. 677.

198 The same system prevails in Ireland, and is considered to be the principal cause of the periodical disturbances which have so frequently distracted the peace of that country. It is, however, only doing justice to the Irish clergy to observe, that this imposition is, in general, levied with moderation, when vested in their own hands; but it too often happens, that they leave their tithes to others, who, to enrich themselves, exact the utmost shilling which law or custom will authorise.—*Remark by Edward Burroughs, Esq.*

199 Brown's Treatise on Rural Affairs, vol. ii. p. 351; Derbyshire Report, vol. ii. p. 30.

200 Worcestershire Report, p. 36.

201 Kent Report, p. 42.

202 Among other objections to taking tithe in kind, it is none of the least importance, that a large proportion of the straw, the chief material from which manure is obtained, is carried off the farm, and the means of preserving its fertility thus impaired. There are some excellent remarks on the subject of tithes, in the celebrated Dean Tucker's Elements of Commerce, sect. 3. p. 56. If

the question should ever come under the consideration of Parliament, that section of the work ought to be reprinted.

203 Dr Skene Keith states, in his Report of Aberdeenshire, p. 176, that no less a quantity than 2000 acres had been trenched in the neighbourhood of Aberdeen, at a heavy expense, which would not have been incurred, to any great extent, if tithes could have been exacted from the lands thus improved.

204 Mr Curwen remarks, that the daily augmentation of the poor-rates is most severely felt; and whilst their oppressive effects are deprecated by all, as likely to absorb the whole landed rental of England, no specific plan for their immediate or progressive reduction, or their remote abolition, is suggested.—*Curwen's Report*, p. 32.

205 Hereford Report, p. 40.

206 Somerset Report, p. 36.

207 Wilts Report, p. 28; Derbyshire Report, vol. iii. p. 184.

208 In Ireland, the same plan is adopted; and the most intelligent statesmen of that country are convinced, that it is the most judicious mode of relieving the poor.—*Remark by Edward Burroughs, Esq.*

209 Clydesdale Report, p. 78.

210 The erection and repair of churches, houses for the clergy, and schools, are parochial burdens, to which landlords in Scotland are liable. Scarcely a year passes without some demand on that account, on the pockets of the proprietors, for one or more of these parochial buildings. The expense varies according to the population and rent of the parish.

211 As specifications are more satisfactory than general assertions, it may be proper to insert the payments made by a farmer in England, whose rent is annually L.500.

Tithes are compounded for at	L.100	0	0
Poor's assessment is 5s. on the pound,	125	0	0
Church assessment,	6	5	0
Highway assessment,	13	10	0
House tax and window tax,	10	0	0
Horse tax and dog tax,	7	10	0
Stamped receipts for these and other payments,	1	15	0
The whole are very nearly 53 per cent., or	L.264	0	0

Communication from John Middleton, Esq.

212 Clydesdale Report, p. 67; Derbyshire Report, vol. ii. p. 492.

213 Brown's Treatise on Rural Affairs, vol. i. p. 185.

214 See the Cornwall Report, p. 22, where an allusion is made to a most distressing circumstance, the author of that work having unwarily expended large sums *on an entailed estate*. This too often happens, and the unfortunate occupier is left at the mercy of his successor in the property. But this can only happen, when the lease granted by the proprietor in possession, exceeds the time he is permitted by the entail to grant such a deed.

CHAP. II.

1 Wilts Report, p. 26. It has been justly remarked, that farmers in general, cannot make their transfers of property, so frequently as manufacturers and merchants; hence they have occasion for, proportionally, even a greater capital at command. The shifts that farmers are often obliged to resort to, for raising money, are highly detrimental to their real interests.

2 Marshall on Landed Property, p. 391.

3 North Riding Report, p. 76. 4 Warwickshire Report, p. 43.

5 Marshall on Landed Property, p. 392.

6 The culture of hops, a species of gardening, requires a capital of from L.50 to L.60 *per* acre.—*Young's Calendar*, p. 482.

7 Leicestershire Report, p. 115.

8 In Essex, L.15 *per* acre is necessary, where draining and chalking are essential. In Flanders, L.6, 5s. *per* English acre is required. The sum is often lower, but then the farmer in general fails, unless he is assisted by an industrious family, or is fortunate in other respects.—*Hints on the Agricultural State of the Netherlands*, p. 9.

9 Cambridgeshire Report, p. 42.

10 Husbandry of Scotland, vol. ii. p. 182; General Report of Scotland, vol. ii. p. 343.

11 The following interesting account is given of the value of the crops on a farm of 530 acres, within seven miles of London, and in the county of Kent, by the occupier, Mr Dickson of Kidbrooke, near Blackheath.

	Produce sold.			Money expended in Improvements.			Increase of Produce by these Improvements.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
1821,	2635	5	5¼						
1822,	3178	15	5	1766	13	4	543	9	11¾
1823,	3912	3	7½	1742	10	0	1276	18	2¼
1824,	5095	17	11½	1790	16	8	2460	12	6¼
1825,	4545	8	7½				1910	3	2¼
1826,	4697	19	6				2062	14	0¾
1827,	4347	2	10½				1711	17	5¼
1828,	5138	11	1				2503	5	7¾
	33,551	4	6¼	5300	0	0	12,469	1	0¼

The annual rent of this farm is L.1500. The farm is tithe free, and extra-parochial. The result is, that for an expenditure of L.5300, or about L.10 *per* acre, the produce of a farm of 530 acres, was raised from L.2635 to L.5138, *per annum*, or nearly double.

Nothing then is wanting to double the produce of the country, but skill and capital, by the proper application of which, our agricultural produce might be doubled, and instead of being an importing, we might again become an exporting country.

12 Husbandry of Scotland, vol. ii. p. 192. The statement is printed in the Appendix to this work, No. IV. "On Farming Accounts."

13 See the particulars in "*Hints on the Agricultural State of the Netherlands*," by the Right Honourable Sir John Sinclair, Bart. printed anno 1815, Appendix, No. III.

14 South Wales Report, vol. i. p. 180.

15 Surrey Report, p. 107; Warwickshire Report, p. 43; North Riding Report, p. 77, &c.

16 Herefordshire Report, p. 42; Warwickshire Report, p. 45; Surrey Report, p. 107, &c.

17 Husbandry of Scotland, vol. ii. p. 237.—Unless stock, for instance, keep at their original value, the farmer may be apparently a gainer, whilst in reality he is losing money.

18 Besides the obvious advantages of enabling a man to understand his own affairs, and to avoid being cheated, it has a moral effect upon the farmer, of the greatest consequence, however small his dealings may be. Experience shews, that men situated like small farmers, (who are their own masters, and yet have very little capital to manage or to lose), are very apt to contract habits of irregularity, procrastination, and indolence. They persuade themselves that a thing may be as well done to-morrow as to-day, and the result is, that the thing is not done till it is too late, and then, hastily and imperfectly. Now nothing can be conceived better adapted to check this disposition, than a determination to keep regular accounts. The very consciousness that a man has to make entries in his books of every thing that he does, keeps his attention alive to what he is to do; and the act of making those entries, is the best possible training to produce active and painstaking habits.

19 Bedfordshire Report, p. 160; Herefordshire Report, p. 42.—The ancient Romans were perfectly aware of the necessity of economy, in cultivation. It was a caution given by Varro, to take care, " *Ne sumptus fructum superet.*" Let not the expense exceed the return. And Pliny is even more pointed, since he delivers as a maxim, " Bene colere lucrosum, optime colere damno-" sum." To till well is profitable; but profuse agriculture is ruinous.—*Coventry's Discourses*, p. 58.

20 By carefully examining the accounts of the smith, the carpenter, and other tradesmen employed by the farmer, important savings of expense may be effected.

21 Mr Blaikie, formerly bailiff to the Earl of Chesterfield, and now to Mr Coke of Norfolk, besides his accounts of money transactions, and an accurate valuation of stock, both dead and alive, annually made out records, of even the most minute particulars; for instance, respecting a hay-stack—the date when carried in; where from; number of waggon-loads; how got in; and the estimated number of tons;—whilst on the opposite side is entered, the date when cut; where used; by what stock, &c.—*Derbyshire Report*, vol. ii. p. 40.

22 This subject is fully discussed in Young's Farmer's Calendar, p. 533 to 549. In regard to accounts, the greatest objects are, 1. Clearness; and 2. Brevity.

The first point, however, cannot be obtained in a large concern, unless the following accounts are kept:

1. A weekly account of receipts and disbursements, with the balance at the end of each week.
2. A monthly account of ditto.
3. An annual account-current, consisting of the several totals of the twelve monthly accounts.
4. A granary account, distinguishing the several quantities of grain of different sorts thrashed out, and the disposal and expenditure of every particular of the same, and what remains on hand.
5. An account of live stock, and the buying and selling, and profit derived from each sort; and,
6. An estimate of the capital employed, or the value of the live stock, crops, manure, implements, and other property, at the commencement of each year, and a statement of the profit or income that has been derived from the farm during the course of the preceding year; Marshall on Landed Property, p. 424; and the Husbandry of Scotland, vol. ii. Appendix, No. 39.

23 The extent should only contain the land cultivated; the fences and borders on a farm, should be thrown into one mass.—*Young's Calendar*, p. 588.

24 Marshall on Landed Property, p. 419.

25 Marshall on Landed Property, p. 420. The Farmer's Calendar, published by Mr Arthur Young, contains much valuable information, and would furnish many useful hints, *for the general memorandum book of business to be done.*

26 Leatham's Survey of the East Riding, p. 61.

27 Marshall on Landed Property, p. 420.

28 Young's Calendar, p. 51.

29 Leatham's Survey of the East Riding, p. 61.

30 Young's Calendar, p. 437.

31 Young's Calendar, p. 483.

32 Ibid. p. 485.

33 The ploughing-matches so frequent in England, Scotland, and Ireland, have been the source of much improvement in this important operation.

34 Bedfordshire Report, p. 582.—This practice prevails much in Flanders. It is productive of much order and decency at meals; and the farmer is thus enabled to return with his men to the work, which may not be the case, when they eat separately.—*Comm. from the Rev. Thos. Radcliffe.*

35 Young's Norfolk, p. 48.

36 Young's Calendar, p. 485.

37 Bedfordshire Report, p. 580.

38 Surrey Report, p. 540.

39 Monmouthshire Report, p. 96.

40 Staffordshire Report, p. 157.

41 Mr Curwen has erected a dozen of cottages for his carters, adjoining to his farm buildings, that the excuse of being a mile and a half from the stables should cease to be an apology for due attention to the horses, and cleaning and dressing them at eight o'clock every night; it being a well-founded maxim, that good grooming is as necessary, and almost equal to good feeding. The advantages derived from this alteration soon became apparent.—*Curwen's Report*, p. 78.

42 This system is fully detailed in the Husbandry of Scotland, vol. ii. p. 240, also in the General Report of Scotland, vol. iii. p. 226. See likewise the West Riding Report, p. 13, and the Surrey Report, p. 540. Both in Berwickshire and Roxburghshire, many farmers have but one unmarried male servant kept on their farm.—*General Report of Scotland*, vol. iii. p. 241, note.

43 Husbandry of Scotland, vol. ii. p. 280.

44 West Riding Report, p. 203.

45 Devon Report, p. 359; Cornwall Report, p. 85.

46 Husbandry of Scotland, vol. ii. p. 106.

47 General Report of Scotland, vol. iv. p. 237.

48 Letter from the Earl of Winchilsea; Communications to the Board of Agriculture, vol. i. p. 80. Many instances are known in Ireland, of labourers who were idle and ill conducted, becoming industrious and peaceable, on obtaining an acre or two of land, to engage them in domestic pursuits. Indeed the Irish peasant prefers what he terms, "*his little garden*," to any increase of wages which might be considered an equivalent; it is, however, often the case, that his poverty incapacitates him from cultivating it to advantage, and thence it becomes a burden to him; being necessitated to pay a heavy rent, and foregoing, for that accommodation, a certain portion of his wages.—*Remark by Edward Burroughs, Esq.*

49 Remarks by Sir John Thomas Stanley, Bart. Cheshire Report, p. 87, note. The gaining of a settlement, by a year of hired servitude, is the occasion of endless feuds and frauds, litigation and expense.

50 Berkshire Report, p. 75.

51 Marshall on Landed Property, p. 105.

52 In Ireland, the labourer has, in some cases, grass for a cow supplied by the occupier of the farm, during the six summer months, at from two to three guineas; and with his cottage, at least a plantation acre, one half for potatoes,

the other for winter forage for his cow.—*Communication from the Rev. Thomas Radcliffe.*

53 Others recommend, as a better system, constantly to mow one half of the land, and to pasture the other, as grass is most productive, when it is uniformly treated according to the same system.—*Communication to the Board of Agriculture*, vol. iii. p. 191.

54 Kent Report, p. 194. 55 Holt's Lancashire, p. 183.

56 West Riding Report, p. 204.

57 Donaldson's Modern Agriculture, vol. i. p. 135.

58 Suffolk Report, p. 223, note.

59 General Report of Scotland, vol. iii. p. 247.

60 Kent Report, p. 194.

61 Holt's Lancashire, p. 183; Staffordshire Report, p. 158.—This objection may be urged in the case of manufacturers, but is certainly not so applicable to those who are employed in agriculture.—*Remark by Edward Burroughs, Esq.*

62 Middlesex Report, p. 380.

63 Mr Dudgeon of Prora's Statement; General Report of Scotland, vol. iii. p. 347, note.

64 In Herefordshire, labourers have worked in harvest fifteen hours a-day; Report, p. 158.

65 Communication from John Middleton, Esq.

66 General Report of Scotland, vol. iii. p. 248, note.

67 Remark by Edward Burroughs, Esq.

68 Middlesex Report, p. 382.

69 General Report of Scotland, vol. iii. p. 346.

70 It is believed, that, in point of nourishment, one peck of oatmeal, weighing $8\frac{3}{4}$lbs. avoirdupois, will go as far in supporting a family, as two pecks or 56 lbs. of potatoes. The peck of oatmeal is not half the price of a peck of wheat. The weight of the latter is from 14 lbs. to 15 lbs.

71 This was ascertained by a respectable magistrate, Sir George O. Paul, Bart., on the most careful inquiry. See his letter addressed to Sir John Sinclair, written an. 1796, p. 7.

72 Staffordshire Report, p. 158.

73 General Report of Scotland, vol. iii. p. 262. The wages of *hinds*, or married ploughmen, have greatly increased. In 1792, they only received thirteen bolls of grain, but it has since been augmented to seventeen bolls, or at the rate of thirty per cent.

74 Bedfordshire Report, p. 415.

75 Dorset Report, p. 439; Devon, p. 365; and Cornwall, p. 159. In Dorset, malt and hops are given to the cottagers, to brew ale for the use of their families, in hay time and harvest.

76 Lincolnshire Report, p. 445, note.

77 Wilts Report, p. 212.

78 The various particulars connected with the management of live stock, are probably still more numerous than those which belong to the raising of the several crops, and the cultivation of the different kinds of land under the care of husbandmen, (Coventry's Discourses, p. 134), and would consequently require a more extensive inquiry.

79 In regard to small-sized sheep, see Dr Parry's Essay on the Merino sheep; Communications to the Board of Agriculture, vol. v. p. 460. By breeding small sheep instead of large ones, the number was increased on the ground of a farmer who tried the experiment, from 660 to 890 ewes and lambs, and the profit from L. 450 to above L.724; *Ditto*, p. 461. They should not, however, be under their pasture, nor of a small sort, on rich land.

80 The *marbling* of meat must in a great measure depend on the age of the animal. When full grown, the Highland stots have been fed to perfection in Norfolk, in even eight months. It is said that the dairy breeds, more especially the Ayrshire, are more apt to be marbled, than any other sort.

81 The late intelligent Mr Davis of Longleat, lamented that the Wiltshire farmers had that "*pride of stock,*" which induced them to prefer beauty and size, to utility and profit.—*Wiltshire Report*, p. 203.

82 Sir John S. Sebright's Letter to Sir Joseph Banks, p. 22.

83 Bedfordshire Report, p. 572.—All the fine breeds have a much less bulk of intestines, and a smaller intestinal canal, than the inferior stock, which is attributed to this, that getting rich food in early life, containing much nourishment in a small bulk, the parts are not so distended, as they would have been with coarser fare.—*Coventry's Discourses*, p. 165.

84 Coventry's Discourses, p. 175, note.

85 These *anatomical rules*, as they are called, have been objected to. It is said, that a broad-chested horse is seldom a good hackney; that in a blood horse, it is desirable that his chest should be lean, and rather tight to the eye; that a broad-chested ox is often light in the flank; and that broad and well spread shoulders indicate a good ox, more than width between the fore-legs. These, however, are only exceptions to a general rule. In regard to sheep in particular, an expanded chest, in which there is ample room for the free play of the heart and lungs, is the characteristic mark of health and vigour in the animal.—*Doctor Rigby's Report*, p. 25.

86 See the paper by Henry Cline, Esq. "On the Form of Animals." Communications to the Board of Agriculture, vol. iv. p. 440.

87 Small bones, like those of the blood horse, are compact and heavy; large bones, like those of the common dray or cart horses, are extremely porous, and consequently light for their apparent bulk.

88 Husbandry of Scotland, vol. ii. Appendix, p. 112.

89 General Report of Scotland, vol. iii. p. 6. Of two calves kept and fed alike, one of the improved breed, the other of the common unimproved stock of the country, the first got fatter and fitter for the butcher at two years old, than the other did at three.—*Durham Report*, p. 236.

90 Coventry's Discourses, p. 179. The same intelligent author justly remarks, that the breeds distinguished by early maturity, do not seem calculated for districts, where the climate is cold, and the food is poor and scanty. Hence it is not improbable, that a slow-growing animal, capable of being sustained on coarser fare, may prove ultimately more profitable in such a district, more especially in cases where richer food is expensive, or acquired with difficulty. Ditto, p. 177.

91 It is remarked in the Highlands, that in bad weather, hardy cattle keep their back bones straight, whereas the more delicate sort set up a hog back. Hence the crooked appearance of bad cattle.

92 Middlesex Report, p. 576.

93 Culley on Live Stock, second edition, p. 43.

94 Coventry's Discourses, p. 183.

95 Answers to Queries, by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 204.

96 Coventry's Discourses, p. 175. Culley on Live Stock, second edition, p. 43. The quality of the flesh is much more attended to in the English than in the Scotch markets.

97 Coventry's Discourses, p. 177, &c.

98 Willich's Lectures on Diet and Regimen, third edition, p. 316.

99 Hints regarding Cattle, from Essays on Miscellaneous Subjects; by Sir John Sinclair, Bart. p. 74.

100 See Answers to Queries regarding Live Stock, by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 108. Dr Stark's experiments go to prove, that three ounces of boiled fat beef are equal, in point of nutrition, to a pound of lean. See a tract printed an. 1801, entitled, "*Practical Economy,*" &c.

101 Young's Lecture on the Husbandry of Three Celebrated Farmers, p. 10.

Mr Mason's Letter to Sir John Sinclair, Farmer's Magazine, vol. xv. p. 60. It appears from Columella's description of the best kind of ox, that the advantage of a soft skin is not a new discovery, but was perfectly well known to the husbandmen of ancient Italy.

102 Husbandry of Scotland, vol. ii. Appendix, p. 110. This is the *technical expression*, though, properly speaking, the man is the handler, and the skin of the beast is handled. We are apt to say, in the same manner, that a horse *rides* well.

103 See Mr Robert Colling's Letter to Sir John Sinclair, Farmer's Magazine, vol. xv. p. 61.

104 The great perfection of an animal is, when the dead weight of all the eatable parts approaches the nearest to the weight of the animal when alive. The following statement of the live and dead weight of a Devonshire ox, aged three years and ten months, will explain the manner in which these accounts are drawn up.

			Stone.
Live weight,			114
Offal.	*Stone.*	*lb.*	
Tallow,	10	6	
Hide,	6	3	
Head and tongue,	2	9	
Heart, liver, and lungs,	2	7	
Feet,	1	4	
Entrails and blood,	11	13	
			35
Butcher's meat, the carcase or four quarters,			79
			114

This proved to be a prime ox, as his beef or available food weighed three stone *more* than *two-thirds* of his live weight. It likewise appears in this case, that 10 stones of live weight, produced 6 stones 13 lbs. of dead weight, or butcher's meat. *Durham Report*, p. 239. The average of other experiments is, from 6 stone 10 lbs. to 6 stone 13½ lbs. of dead weight, to 10 stone of live weight. When an ox is fed for two years in succession, a much higher proportion of dead weight is the result, though it hardly ever exceeds three-fourths of the live weight, or as 15 is to 20.

In sheep, on an average, from 10 lb. of living weight, to 6 lb. 7 ounces of dead weight, convertible into food, may be obtained ; *Durham Report*, p. 251 ; consequently, in this respect, cattle are superior to sheep. With the view of increasing the available food, Mr Cline strongly recommends the breeding of sheep and cattle without horns, which, he observes, are useless to the animals themselves, and often a cause of accidents to others. Where a ram is horned, the skull is extremely thick, and with the horns, often weighs five times more than another skull that is hornless. Animals without horns, are, in general, tamer, and less vicious, and would produce more meat, and other valuable substances, if that apparently useless appendage did not exist.

105 But when the properties essential in forming a perfect breed, are fully ascertained, the separation of occupations, above alluded to, will become useful, as one farm may be better calculated for breeding, another for fattening, &c.

106 Sir John S. Sebright's Essay on the Art of improving the Breed of Domestic Animals, p. 5 and 8.—All breeding proceeds on the presumption, that the tendency of any individual animal is, to transmit to its offspring, the form, constitution and qualities which it possesses ; and as two animals are concerned in the production of one offspring, that one is expected to inherit a form and constitution compounded of the joint qualities of its two parents. Thus it is found, in numerous breeds of animals, as in deer,—in the West Highland

cattle,—in the North Devon,—and in the wild cattle of Chillingham Park, that the offspring, for an indefinite number of generations, have borne the same general characters.—*Observations by C. Mason, Esq. of Clifton, Co. Durham.*

107 Sir John S. Sebright's Essay, p. 7. Incessant care and attention, however, are necessary, to keep them up to the mark ; and this is rather fortunate than otherwise, since it perpetuates the *merit* of breeders, and the competition of stock.

108 Young's Lecture, p. 9.

109 It having been found, that this system produced animals quite deficient in vigour, those who are now possessed of a capital stock, keep two or three *streams of blood*, quite distinct, that they may avoid a consanguinity.

110 Sir John S. Sebright's Essay, p. 13. Paper by Henry Cline, Esq. Comm. to the Board of Agriculture, vol. iv. p. 442.

111 Paper by T. A. Knight, Esq. Comm. to the Board of Agriculture, vol. ii. p. 185. These dwarfish males however, may not have an injurious effect on the stock of another person, especially the first cross, if the females be of a coarser quality, and, on Mr Cline's principle, if they are of a larger size than the males put to them.

112 Paper by T. A. Knight, Esq. Comm. to the Board of Agriculture, vol. ii. p. 185.

113 Sir John S. Sebright's Essay, p. 13.

114 Paper by T. A. Knight, Esq. Comm. to the Board of Agriculture, vol. ii. p. 186.

115 Husbandry of Scotland, vol. ii. Appendix, p. 109. The same rule holds good regarding the human species. By a train of unfortunate circumstances, a brother and sister german, ignorant of their consanguinity, were married. They had ten children, all of whom died before their parents.

116 Paper by T. A. Knight, Esq. Comm. vol. ii. p. 172.

117 Sir John S. Sebright on improving the Breeds of Domestic Animals, p. 11 and 14.

118 General Report of Scotland, vol. iii. p. 17.

119 Husbandry of Scotland, vol. ii. Appendix, p. 109.

120 Paper by Henry Cline, Esq. Communications to the Board of Agriculture, vol. iv. p. 445. This appears to be an important rule.

121 A single cross, without breeding from either the males or the females thus produced, is often more profitable than the pure breed ; but if the crossing is continued, many inferior animals will be found in a flock. Hence it is, that improving a breed already established, by judicious selection, is to be preferred with a view to permanent advantage.

122 Mr Cline's doctrine has been much misunderstood. He does not require that the female should be larger than the male, but larger in size, *than is usually the proportion* between females and males. Communications to the Board of Agriculture, &c. vol. iv. p. 440. Where the female is too small, or the male too large, the offspring is generally ill-shaped. A gentleman in Forfarshire rears an excellent breed, by crossing the large Angus cows with a small Highland bull from Lochaber.

123 Dr Parry's Paper, in the Communications to the Board of Agriculture, vol. v. p. 339. This would be the case, if the sheep got as much salt as the Merinos are supplied with in Spain, as salt has a peculiar property in improving the pile of all animals.

124 Communications to the Board of Agriculture, vol. ii. p. 178.

125 Answers by T. A. Knight, Esq. Husbandry of Scotland, vol. ii Appendix, p. 104.

126 See Letter from the celebrated farmer, Mr Robert Colling, to Sir John Sinclair, Farmer's Magazine, vol. xv. p. 61. Mr Cline is of that opinion. He observes, that if a hornless ram be put to horned ewes, almost all the lambs will be hornless.

127 An Essay on the question, whether the greatest improvement is susceptible from the qualities conspicuous in the male, or female parent, by the Rev. Henry Berry. It received the honorary medal from the Highland Society of Edinburgh. It is printed in the British Farmer's Magazine, for February 1831, and other periodical publications at that time.

128 Answers by T. A. Knight, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 104 and 105.

129 General Report of Scotland, vol. iii. p. 21.

130 Coventry's Discourses, p. 160.

131 This was the practice of the late Duke of Bedford.—*Young's Calendar*, p. 511.

132 Remark by C. Mason, Esq. of Clifton.

133 This is the opinion of Messrs Bailey and Culley, the intelligent authors of the Northumberland Report. See p. 166.

134 It is well observed in the Northumberland Report, (8vo edition, p. 160), that improvements in stock are not so easily spread as those of cultivation. If a farmer sees any modes of practice more beneficial than those he knew before, he can readily adopt them ; or, if he discovers and selects a new variety of any species of grain, more productive and more valuable than any hitherto known, it multiplies so fast, that it is readily disseminated ; but improved breeds of stock are not so readily diffused ; they are much slower in their propagation, and much more easily contaminated, and are only to be preserved by attention and judgment.

135 Coventry's Discourses, p. 144.

136 It is hardly to be credited what pains are taken to keep animals in a fat state. A farmer who was ambitious to excel, had purchased an extraordinary bull from one of those fancy breeders, and complained to his former owner that the animal was fast declining, although he had plenty of grass, hay, &c. ; on which his former proprietor explained to the farmer, " that grass and hay were not sufficient ; for besides these, he had been fed on grain, and had also been indulged with a pail of milk every day, from the time of his quitting his mother." This was purchasing good condition at a heavy price.

137 Middlesex Report, p. 228.

138 Coventry's Discourses, p. 166 and 168.

139 Coventry's Discourses, p. 145. Bleeding the lambs liable to have that inflammatory disease, called the *braxy* in Scotland, and giving them opening medicines, or green food, would, in a great measure, prevent the ravages of that disorder.

140 General Report of Scotland, vol. iii. p. 22.

141 Paper by T. A. Knight, Esq. Communications to the Board of Agriculture, vol. ii. note, p. 186.

142 Perhaps the Herefordshire cattle approach the nearest to that perfect state, of any of the larger breeds. They arrive soon at maturity, and are fit for labour ; but it is a different variety of the same breed, that is preferred for the dairy.—*Paper by T. A. Knight, Esq.* Communications to the Board of Agriculture, vol. ii.—Mr Coke of Holkham has chosen the North Devons in preference ; and with the care he has bestowed on the breed, he has already arrived at considerable success. The Ayrshire are perhaps the best milkers of their size in Great Britain, and at the same time are excellent feeders when dry of milk, for they fatten faster, and to as great an extent, as any of the other breeds in Scotland. They have scarcely ever been tried in either plough or cart ; but as they travel well, and are strong and alert, they would probably do as well in the cart or plough as any other cattle of the same weight.

143 Husbandry of Scotland, vol. ii. Appendix, p. 112. General Report of Scotland, vol. iii. p. 7.

144 Wiltshire Report, p. 155.

145 This is a practice which the Norfolk farmer should adopt ; and indeed

the importation of oats ought to be prohibited, as barley would answer as well, and its sale ought to be promoted.

146 Wiltshire Report, p. 152.—It may thence be asserted with justice, that the benefit the Wiltshire farmers derive from their excellent markets, are not commensurate with the expense of maintaining these fine horses, to carry the grain they sell to them.

147 Coventry's Discourses, p. 47. It is remarked by an intelligent author on matters of husbandry, that a great diversity of implements, as they are more rarely used, prove in general a source of vexation and disappointment, rather than of satisfaction to the farmer. The operations of husbandry cannot be performed by them properly, unless the person who is to use such implements, has obtained that facility in the use of them, which continued practice can alone insure.—*Anderson's Recreations*, vol. iv. p. 47.

148 Kent's Report of Norfolk, p. 121.

149 Essex Report, vol. i. p. 128. It is disputed, whether the swing or the wheel plough is least liable to friction. The additional action of the wheels, must certainly occasion more friction; but, on the other hand, it is contended, that as a plough must have a tendency to go a certain depth, the pressure is relieved, and the draught is lightened, by having wheels in front. That objection is now completely obviated, by Wilkie's plan of having a small wheel under the sole of the plough.

150 Middlesex Report, p. 89.

151 Middlesex Report, p. 86.—An engraving of the improved swing plough, and an explanation of the principles on which it ought to be constructed, will be found in the Appendix.

152 The practicability of ploughing strong clay soils, at all seasons of the year, with a pair of horses, is much doubted by Mr Lawrence, an experienced agriculturist, in a communication sent by him to the Farmer's Journal, in June 1831. He contends that there are clays, which no two-horse plough, however powerful the cattle, or scientifically constructed the implements, would be able to stir to advantage. He admits, at the same time, that real and considerable improvements have been effected in ploughs and shares, by the inventive and ingenious heads of the mechanists of the North; and he laments that he has never enjoyed an opportunity of examining the soils of Scotland, or of visiting *that "great modern storehouse of human intellect."*

153 Hertfordshire Report, p. 36; Surrey Report, p. 128, 129.

154 This is certainly an advantage in ploughing up clover leys, or lands where sheep have been fed on turnips, where a furrow-slice *of a regular depth,* is particularly desirable.

155 Middlesex Report, p. 89. To oblige the ploughman to walk upright, and to carry his own weight, the Norfolk and Suffolk ploughs, have but one handle, which soon tires the hand of the man who presses upon it. Ditto.

156 Surrey Report, p. 123. 157 Wilts Report, p. 68.

158 Middlesex Report, p. 92.

159 Lord Somerville's Paper, in the Communications to the Board of Agriculture, vol. ii. p. 418. In the papers of the Bath Society, vol. x. p. 82, there is an account by the late John Billingsley, Esq. of 385 acres being ploughed in eleven months by a team of six oxen, a ploughman, and driver, by a double-furrowed plough. They also harrowed at the same time 291 acres.

160 Surrey Report, p. 123.

161 Huntingdonshire Report, p. 32. In some cases, instead of the *sheath,* they make use of a *slice,* as it is called, a sort of knife, difficult to describe, but calculated to effect the paring of a very tough dry surface.

162 Subjoined to the Select Transactions of the Society of Improvers in Scotland, printed in January 1743, is this advertisement: "The Rotherham plough, the drill plough, and the horse-hoeing plough, are better made by Mr Dalziel, at Newliston, near Lord Stair's house in West Lothian, than by any

other in this kingdom." This proves the period of the introduction of these implements into Scotland.

163 In the transactions of the Highland Society of Scotland, vol. iv. p. 243, there is a favourable report of Veitch's improved plough, with an engraving of it. It is longer than Small's plough, and more likely, on that account, to be adopted in England, where length is preferred. An improvement in the plough-ear, or mould-board, of swing ploughs, has been recommended by the celebrated Jefferson, formerly President of the United States of America, who has cultivated the mechanical branches of agriculture with much success. A particular description of it is to be found in Brown's Treatise on Rural Affairs, vol. i. p. 260. The plan was tried, at the desire of the Board of Agriculture, by C. C. Western, Esq. M.P. of Felix Hall, in Essex; when it appeared, that it was constructed on a new and very ingenious principle. It was found, however, liable to this objection, that from the concavity, or flatness in the fore part of the breast, the loose earth of the furrow was apt to rest upon it.—*Essex Report*, vol. i. p. 138. See a valuable paper on the plough, in the Quarterly Journal of Agriculture, No. 4, p. 409, February 1829.

164 Middlesex Report, p. 96.

165 Derbyshire Report, vol. i. p. 48.

166 The edges should not be sharp, as they would cut the root-weeds, and render it more difficult to collect them.

167 Middlesex Report, p. 66.

168 There is a particular account of the introduction of the grubber or scarifier into Scotland, in the Transactions of the Highland Society, vol. iv. p. 549. Mr Fellenberg, the celebrated Swiss agriculturist, has sent to the Board of Agriculture, the model of a scarifier, with the coulters extremely bent, and without wheels, consequently the machine would be much cheaper, if, upon trial, it were found equally effectual.

169 See Communication from Mr Robert Hope, of Fenton, in East Lothian. Appendix, No. V. He there observes, that the plough is necessary in fallows, to eradicate thistles, from the fast hold they take of the ground; but the grubber will extirpate every other root-weed. In soils where it is likely to be choked, the number of coulters should be diminished.

170 Suffolk Report, p. 36.

171 Warwickshire Report, p. 60.

172 Surrey Report, p. 140.

173 Durham Report, p. 85. The Hertfordshire practice of sowing under furrow, is described in the County Report.

174 From Lowthrop's Abridgment of the Philosophical Transactions, vol. ii. p. 738, it appears that a *Sembrador*, or drill-machine, was invented in Spain, prior to the year 1663. They were of still greater antiquity in the East Indies.

175 In Mr Brown of Markle's valuable work, "Treatise on Rural Affairs," vol. i. p. 296, &c. there is a good account of Mr Bailey's drill-machine.

176 Dr Rigby's Report on the Husbandry of Holkham, p. 53.

177 There is a particular description of this drill barrow, accompanied with a plate, Appendix, No. IX. It is a most valuable instrument on small farms.

178 More complicated machines have been invented, as "*the self-sowing dibble*," &c.; but the simple one is generally preferred.

179 In this case, the dibble has an injurious effect, by placing the seed in a hollow pot, which collects and retains moisture; and encircling it in a socket of so tenacious a material as clay, through which water cannot percolate, or by any means be discharged, it stints the growth of the plant, and often causes the seed to decay before it vegetates.—*Remark by the Rev. Robert Hoblyn.*

180 Gloucestershire Report, p. 125 and 129.

181 Vide Chap. IV. Sect. XVIII

182 The Right Honourable Sir George Rose, Bart. has great merit, for his exertions to establish the use of this implement in Hampshire.

183 A machine for that purpose, has been invented by Mr Smith, near Dum-

blane, in Scotland, which displays much ingenuity; but it seems to be brought to still greater perfection, by the Rev. Mr Peter Bell of Forfarshire.

184 A great improvement has been made in the form of these cast-iron pillars. They ought to be cast in *two* pieces, the head separate from the rest. It is thus of a cheaper construction; and if the head is bent inwards, the access of vermin up the pillar, becomes impracticable.

185 Particular care should be taken, not to leave ladders, or other articles leaning against the stacks, for the vermin will climb up them.

186 When frames or bosses are placed in the centre of stacks, either small frames, or bunches of brush-wood, should be put in at two or three places, about six or eight feet from the ground, and reaching from the outside, to the centre of the stack, so as to admit air, and create ventilation.

187 Husbandry of Scotland, vol. i. p. 79. Every friend to merit must rejoice to hear, that the inventor of so important a machine, was rendered comfortable in his old age, and enabled to provide for his family after his death, by the voluntary donations of his grateful countrymen.

188 The advantage of using oxen, as the best animal power, can hardly be doubted, provided the machines are very highly calculated.

189 A man and boy, with three horses, move from one farm to another, hire themselves with their machines, for twenty shillings a-day, and do their business well and very clean, without damaging the straw. The hirer or farmer keeps both men and horses. Nearly two loads of wheat are thrashed *per* day, the load being 40 bushels, and the whole charge sixpence *per* bushel.

190 This plan is the most likely to be adopted in foreign countries.

191 See an instance of this in the Kent Report, p. 59, where the bakers of Deal and Dover, were thus immediately supplied with flour, which otherwise might not have been practicable.

192 The thrashing-mill has been objected to, as diminishing the field for labour. But those who are thus deprived of work, might be much more advantageously employed in making the farm roads.

193 This process is called in Somerset, "*Ear-Pitching*." The implements are simple, and the process not difficult to execute. After a sufficient number of ears are accumulated upon the floor, the work of thrashing is executed by the common flail. By this process, the grain raised on the proposed parochial dairy farms ought to be thrashed.

194 Husbandry of Scotland, vol. ii. Appendix, No. 6.

195 This useful machine, it is said, originated in China, and, along with that for making pot-barley, was introduced into Scotland from Holland, about a century ago, by Mr James Meikle, father of Mr Andrew Meikle, inventor of the thrashing-mill. Mr Fletcher of Salton sent him to Holland for that purpose. See Farmer's Magazine, vol. i. p. 158.

196 General Report of Scotland, vol. i. p. 232.

197 It may be proper to state, that they are variously made up, and are in some places very defectively put together, for mowing smoothly, and with care. In some parts of Bedfordshire, they excel in this particular.

198 There is a particular description of this machine, invented by John Middleton, Esq. in the Transactions of the Society of Arts, vol. xiv. p. 190.

199 See Annals of Agriculture, vol. xxix. p. 148; the common carters in Lanarkshire, frequently put from 30 to 40 cwt. and sometimes even more than 50 cwt. upon a single-horse cart. They carry from 30 to 40 cwt. of coals, for the Glasgow Gas Company, conveying them 18 miles, where much of the road is steep. The stones for the new Hamilton Palace are brought 9 miles, and frequently from 35 to 45 cwt. on one cart. Those brought from a nearer quarry, though part of the road is steep, have in many cases more than 50 cwt. put on a single horse, besides the weight of the cart, which is from 7 to 9 cwt. more.

200 Indeed, Dr Anderson maintains, that the same number of horses, with

carts properly constructed, will do no more than double the work in harvest, than can be done by waggons; but were the difference only from two to three days in a week, that is of immense consequence in a precarious climate. Dr Anderson's Recreations, vol. iv. p. 112. Waggons are sometimes detained two hours in a field before they are filled.

201 Lord Robert Seymour's Paper, Annals of Agriculture, vol. xxvii. p. 337. It is there maintained, that two horses singly, will do as much as three conjunctively.

202 Paper by Arthur Young, Esq. Annals of Agriculture, vol. xviii. p. 178. In Ireland, the Scotch dray and cart are very generally in use, the former for conveying goods and merchandise, and the latter for agricultural purposes. From 20 to 25 cwt. is a very common load for one horse under a dray, which generally travels at the rate of 20 miles per day.—*Remark by Edward Burroughs, Esq.*

203 Middlesex Report, p. 94.

204 Surrey Report, p. 139.—It is surprising that so prudent and intelligent a people as the English did not find this out long since.—*Remark by Edward Burroughs, Esq.*

205 Communications to the Board of Agriculture, vol. ii. p. 415.

206 Ibid. vol. ii. p, 417.

207 Derbyshire Report, vol. ii. p. 61.

208 Remark by Edward Burroughs, Esq.

209 Middlesex Report, p. 94.

210 Anderson's Recreations, vol. iv. p. 14.

211 See Chap. III. Sect. 3.

212 Buckinghamshire Report, p. 114. Mr Coke of Holkham has a cast-iron roller that cost L.60. It weighs three tons and a half. It is five feet six inches in diameter, as well as in length. It leaves the grass fields in the best possible order.—*Young's Norfolk*, p. 50.

213 Essex Report, vol. i. p. 147.—The drill roller is an efficient instrument for breaking down the clods of rough fallows.—*Derbyshire Report*, vol. ii. p. 46. —The spike roller is well calculated for stony clays, and will bring them into a pulverized state, at a trifling expense. By the common roller, large lumps cannot be reduced, unless they are in a moist state; whereas the spike roller will accomplish that object, however large or hard they may be.—*Remark by Edward Burroughs, Esq.*

214 Husbandry of Scotland, vol. i. p. 118.

215 There is an engraving of this implement in the Appendix, Plate IV. It was first heard of at the Board of Agriculture from Wales. Doctor Skene Keith since states, that it has been used in Aberdeenshire for these forty years past. In Lambert's Travels through Lower Canada and the United States of America, (printed in London, an. 1810), vol. ii. p. 109, the following account is given of the American cradle churn: "At a farmer's near Lake Champlain, we saw a machine for churning butter. It was a kind of half barrel, with a place where one of the farmer's sons sat astride as on horseback. The machine moving up and down, answered the double purpose of a churn for making butter, and a rocking horse for his children."

216 Derbyshire Report, vol. ii. p. 56.

217 In the Communications to the Board of Agriculture, vol. iv. p. 296, there is an account of Mr Pierrepont's mode of baking potatoes, and an engraving of the oven. The plan answers so well, that even large oxen are fattened on them, when thus prepared.

218 General Report of Scotland, vol. i. p. 248. The calculations of Edward Borroughs, Esq. go still farther. He is confident, after the experience of four years, that he has saved one-third of corn, in the quantity, which his horses would have otherwise consumed, had it been given them unbroken.

219 Mr Salmon, of Woburn, has invented a portable machine for weighing oxen, at from L.25 to L.30.—*Bedfordshire Report*, p. 215.

220 Called also the plough-ear,—earth-board,—plat,—wrest, &c. &c.

221 Husbandry of Scotland, vol. ii. Appendix, No. 5, p. 28. Some directions for cutting down, and preparing wood for agricultural machinery, extracted from Lord Kames's Gentleman Farmer, will be found in the General Report of Scotland, vol. i. p. 251.

222 In laying by a plough, the share should always be knocked off, and the *head*, or bottom, cleaned from earth.

223 Coventry's Discourses, p. 49. General Report of Scotland, vol. i. p. 252.

224 Curwen's Report, p. 77.

225 General Report of Scotland, vol. i. p. 125. Surrey Report, p. 78.

226 In the Bedfordshire Report, (p. 20), there are two plans of houses, of equal area, one square, the expense estimated at L. 733, and the other octagonal, at L. 671 ; but except where the houses are very wide, or where wood is very dear, the square shape is reckoned the most economical. It may not be improper to add, that in preparing lime for plastering the inside of a house, it should, when quick, be immersed in *hot* water, instead of cold, which rarifies the air in every particle of the lime, makes it softer to work, and prevents it entirely from blistering.

227 It is much to be lamented, that the old mode of open-field tillage, and collecting all the farm-steads of the neighbourhood, into one spot, should still continue in many parts of England. Where this miserable system is persevered in, all the corn must be carted into the village, and all the manure carted back, sometimes up and down steep hills, with immense labour, and an increased wear and tear of the stock and implements.

228 Husbandry of Scotland, vol. i. p. 20. Where it is practicable, it is of great importance, that the house should be so situated, that the farmer can see several fields on his farm, and at the same time can command a full view of the farm-yard, that the doors of the several buildings in it, cannot be opened but in sight of the master's sitting room.

229 Communications to the Board of Agriculture, vol. i. p. 46.

230 Kent's Norfolk, p. 112.

231 In exposed situations, where no part of the house is intended to be shaded from the western sun by an adjoining building, the house should front the south, and the south-west angle should be extended to contain the kitchen, leaving a passage, or common entrance, west, between the kitchen and parlour. In this case the dairy and cellar, larder and store-room, may be commodiously shaded from the south and west, and thorough-air may be obtained from the passage.

232 Communications to the Board of Agriculture, vol. i. p. 7.

233 To large barns there are many objections. If corn is damp, when put in a barn, it is more liable to heat and settle, and more difficult to turn over. Indeed in a late and wet climate, where corn can hardly keep in a stack, it is infatuation to put it in a barn.—*Curwen's Report*, p. 84.

234 General Report of Scotland, vol. i. p. 128.

235 Thin flat stones employed in a roof, are much improved, by the practice adopted in Dumfriesshire, of painting over with coal-tar, or coal oil. A covering that was almost useless in a moist climate, is thus rendered impervious to water ; and straw roofs being thence rendered unnecessary, a great addition is made to the dunghill.—*Dumfriesshire Report*, Appendix, p. 507.

236 In Monmouthshire, they build two cottages, one above another, and the lower one is arched.—*Report*, p. 28.

237 General Report of Scotland, vol. i. p. 130.

238 Remark by Mr Middleton.

239 Middlesex Report, p. 41.

240 Coventry's Discourses, p. 52.

241 Kent's Norfolk Report, p. 111.

242 Suffolk Report, p. 10. In England, the expense of erecting or repairing farm-houses and offices, is in general regulated by the custom of the estate. If the landlord finds materials, it is not without stint or controul; and if the tenant is bound to pay the labour, he cannot be compelled to erect large and unnecessary buildings, against his will.

243 Husbandry of Scotland, vol. i. p. 26.

244 Remark by Edward Burroughs, Esq.

245 Kent's Norfolk, p. 116.

246 For this purpose, it is recommended by Professor Jameson of Edinburgh, that an iron or copper rod, three quarters of an inch in thickness, and pointed at both extremities, should be placed so, that the top shall project over the highest part of the building, and the lower end to go below the house, and be connected with the nearest piece of water. All the metallic parts of the roof should be connected with the rod; and as chimneys, owing to the charcoal and soot they contain, are good conductors, the rod should be placed near them, but *always higher*.

247 Lincolnshire Report, p. 16.

248 East Riding Report, p. 218.

249 Hants Report, p. 48. The scarcity was so great, that it was said, "there is more strong beer than water within the boundaries of the parish."

250 Shropshire Report, p. 29; Bedfordshire Report, p. 19; Worcestershire Report, p. 20. How preposterous, to erect farm-buildings and barn-yards, in low, marshy and boggy spots, fit only for the resort of frogs and wild ducks.—*Communications to the Board of Agriculture*, vol. i. p. 44.

251 It may be done by two water butts, placed on different vessels for filtrating the water by ascent. From the filter, it should be conveyed to a *tank* under the ground, and there it may be preserved for use. When any of this water is wanted, it must be raised by a pump, as is usual in the case of a well. Those who live in countries abounding with water, have no conception of the importance of such hints, to districts inadequately supplied with that essential article.

252 Remark by Mr Middleton. See an instance of roof-water being collected.—*Derbyshire Report*, vol. ii. p. 14.

253 There are few springs like that of St Winifred in Flintshire, which, according to an accurate experiment, emits water at the rate of 120 tons a minute, and in the short space of one mile and 274 yards, is the agent by which eleven mills, of complex machinery, are driven.—*North Wales Report*, p. 75.

254 Middlesex Report, p. 34, note; Surrey Report, p. 70.—Lord Spencer's well at Wimbledon, is 563 feet deep.—*Manning's History of Surrey*, vol. iii. p. 272.—Aikin's Hist. of the Environs of London, 1 vol. 4to, printed an. 1811, p. 127.

255 Hants Report, p. 48.

256 Hants Report, p. 47; Lincolnshire Report, p. 17; Norfolk Report, p. 15.

257 Gloucestershire Report, p. 31. Some ponds at Holkham, done in the Gloucestershire fashion, cost L.28 each.

258 Derbyshire Report, vol. i. p. 494.

259 East Riding Report, p. 218.

260 North Riding Report, p. 242.

261 Wilts Report, p. 13.

262 North Riding, p. 241. It would be a great advantage, by such artificial rills, to convey water sufficient for the use of a thrashing-mill. But this can hardly be done without a considerable *tank* or reservoir.

263 See an account of Mr Dudgeon of Prora's interesting experiment.—*Husbandry of Scotland*, vol. i. p. 100.

264 Derbyshire Report, vol. i. p. 495.

265 Husbandry of Scotland, vol. i. p. 41.

266 Where the hills are steep, horizontal ploughing is to be preferred *on light*

soils, because sudden rains are not so apt to enlarge the furrows, and to waste the soil. This plan has been adopted in America.

267 Derbyshire Report, vol. ii. p. 235.

268 Communications to the Board of Agriculture, vol. ii. p. 251.

269 See the substance of a Communication from William Cuningham, Esq. of Lainshaw, in Ayrshire, upon this subject, Husbandry of Scotland, vol. i. p. 67.

270 Mr Blaikie, in his Observations on the Economy of Farm-yard Manure, and on other Rural Subjects, has discussed the formation and improvement of roads, with his usual ability; and Mr Loudon M'Adam's exertions, are of such importance for promoting these objects, that they cannot fail to make a new era in the History of Road-making.

CHAP. III.

1 All soils, by being cropped, have their fertility more or less diminished, and, in process of time, cease to be any longer productive. Hence the necessity of renewing their powers by manures of various descriptions. Some lands have borne crops of corn for a number of years, without their showing any signs of exhaustion; but such soils have, in general, something peculiar in their situation, composition, or subsoil, or the ingredients of which they are composed, as to give them so peculiar a property.

2 Communication by John Middleton, Esq.

3 Coventry's Discourses, p. 101.

4 The extent of peat soil in Ireland is very considerable. The following is its estimated amount:

	English acres.
1. Flat red bog, capable of being converted to the general purposes of agriculture, ..	1,576,000
2. Peat soil covering mountains, capable of being improved for pasture, or beneficially applied to the purposes of plantation,	1,255,000
Total,	2,831,000

See 2d Report, on the State of Disease, &c. in Ireland, printed by the House of Commons, 7th June 1819, Appendix, p. 156. In the Appendix there is a number of valuable hints, on the means of improving the bogs of Ireland, from which the practicability, and the utility of that system, is clearly proved, and the great probability, if not the certainty, that it would be attended with profit. Mr Griffiths junior recommends, as the best rotation for such land, 1. Rape for seed; 2. Potatoes in drills; 3. Oats, with grass-seeds; and, 4. Meadow. This rotation, he is of opinion, would yield as much produce, as would pay for the expense of bringing the lands into a fertile state, and cultivating them afterwards. It is said, (Report, p. 168), that rye is frequently good, when other crops fail.

Mr Burroughs observes, that since an additional duty has been imposed on foreign rape, that article would pay well; and no crop is more abundant, or less precarious, on boggy soils.

5 See Chap. I. Sect. 2. where mention is made of such lands when improved, becoming, under judicious management, perpetual meadows. In regard to manure for such soils, is has been remarked, that the peat, whose texture is the

least fibrous, and which has the least porosity, is the most easily divided, and is best calculated for putrescent manures. The fibrous peat requires the application of lime.

6 Dr Coventry recommends the drainage of flow mosses, for several years, before their cultivation is attempted.—*Discourses*, p. 110.

7 Communication from John Middleton, Esq.

8 Coventry's Discourses, p. 114.

9 It is difficult to improve land, which has been covered by the sea at every neap tide. A field of this sort has been fenced off from the sea near Exmouth, and for seven years it would not produce either corn or grass, or even pulse of any kind; indeed it still remains perfectly barren, yet the earth seems fine, and rich in quality.

There must have been something peculiarly deleterious in the sea salt with which it is saturated.—*Remark by the Rev. Robert Hoblyn.*

10 Coventry's Discourses, p. 119. They pay much attention, in several parts of the Continent, in particular on the shores of the German Ocean, to prevent these "*sand-floods,*" as they are termed. A small rivulet, or the planting of *Arundo arenaria*, are found to be the most effectual barriers against their encroachments.

11 Communications to the Board of Agriculture, vol. ii. p. 257.

12 Hants Report, p. 297; Annals of Agriculture, vol. ii. p. 412.

13 Oxfordshire Report, p. 221.

14 Communications to the Board of Agriculture, vol. iv. p. 42.

15 Marshall's Yorkshire, vol. i. p. 316. In Oxfordshire, on the other hand, owing to the great scarcity of fuel, the roots pay one-half of the expense. *Report*, p. 223.—In America, they find that the roots of the maple and the beech, decay of themselves in four or five years. The roots of the oak require a longer period.

16 Remark by John Middleton, Esq.

17 Stirlingshire Report, p. 213.

18 Perthshire Report, p. 329. It is advisable to leave the roots where they are not worth the expense of removing, only boring a hole in the middle, which brings on rottenness, even in two or three years.

19 Communications to the Board of Agriculture, vol. ii. p. 260.

20 Oxfordshire Report, p. 232.

21 *Pteris aquilina.*

22 In pasture lands, they have been destroyed, by cutting them twice in the season, by the scythe or hook.—*Remark by Edward Burroughs, Esq.*

23 Oxfordshire Report, p. 234, and 240. The Rev. Robert Hoblyn has completely eradicated fern, by a tedious, but effectual process. He employed a weeding woman to cut off the fern, when young and full of sap, (about five or six inches high), just below the surface of the ground; and another woman, with a basket of old salt, to apply a pinch of it, to the severed and bleeding root. The acridity of the salt destroyed the weed.

24 General Report of Scotland, vol. ii. p. 359. Some have improved heathy pastures, by pulling up the heath, where it was long and thick, then sowing grass-seeds, and applying a moderate dressing of hot lime, by which means the land was soon converted into excellent pasture.

25 Statistical Account of Scotland, vol. iv. p. 465.

26 Communications to the Board of Agriculture, vol. ii. p. 264.

27 Ditto, vol. ii. p. 266, 268.

28 Lincolnshire Report, p. 255.

29 Remark by John Middleton, Esq.

30 Remark by the Rev. Robert Hoblyn.

31 Communications to the Board of Agriculture, vol. ii. p. 253.

32 A wooden bolt, to unite the horse-trees to the chain of the plough, may prevent mischief by giving way.

33 General Report of Scotland, vol. ii. p. 256; Kames's Gentleman Farmer, p. 58.

34 One was invented by the Rev. Mr Ramsay, of Maderty, in Perthshire, and is described in the Statistical Account of Scotland, vol. xix. p. 565. Another machine has been successfully used by Mr Spottiswoode, of Spottiswoode, in Berwickshire, originally invented by Mr Robert Richardson, of Keswick in Cumberland. See Transactions of the Society of Arts, vol. xxvi. p. 190.

35 North Riding Report, p. 208 and 213.

36 See an account of Sir John S. Sebright's Experiments, Herts Report, p. 130.

37 There is an interesting paper on Trenching, by the Rev. Dr Skene Keith, in the General Report of Scotland, vol. ii. p. 395.

38 Mr Monteath of Closeburn, and Mr Maclean of Mark, recommend, as a beneficial practice, to trench or delve mossy soils, to bury the light surface, and to bring up the black decayed moss, which is much better calculated for improvement than the surface.—*General Report*, vol. ii. p. 348.

39 General Report of Scotland, vol. ii. p. 400.

40 Kincardineshire Report, p. 398.

41 Marshall on Landed Property, p. 46.

42 Huntingdonshire Report, p. 301.

43 Communications to the Board of Agriculture, vol. ii. p. 451.

44 Ditto, p. 44.—In Young's Norfolk, Chapter VI. on Inclosures, various instances are given, of the success attending this mode of improvement. This dressing adds rather more than half an inch of calcareous earth to the soil.

45 Clydesdale Report, p. 150, note.

46 Carse, it appears, is a Welsh word; but spelt *corse*. It implies in Wales, wet or fenny land. See the South Wales Report, vol. ii. p. 93. and 102.

47 General Report of Scotland, vol. ii. p. 364. In the Appendix to that Report, vol. ii. p. 38, there is a particular account of this singular and important improvement, against which some prejudices are entertained, by those who have not seen the effects. The alluvial soil at the bottom, is found to be greatly preferable to the peat above it, a mixture of which, however, is considered to be useful.

48 In the Communications to the Board of Agriculture, vol. ii. and in the second Report from the Select Committee of the House of Commons, on the state of disease and the condition of the Labouring Poor in Ireland, (printed in June 1819), there are engravings of these pattens, and a description of them.

49 See Mr Aiton's valuable Treatise on the Improvement of Moss-Earth, printed an. 1811, in which the subject is very thoroughly investigated, and much practical information is detailed.

50 It may be proper to mention here, the superior importance of lime in cultivating waste lands. Mr Simpson, near Pickering, in Yorkshire, in the course of improving some waste lands, left one acre of as good soil as any of the rest unlimed. The first crop was turnips, in which it was not perceptible: but it was strikingly marked in the next crop, that of oats, and still more so in the grass-seeds, as very little clover was seen. The other part of the field became tolerably good herbage, with some small branches of ling or heath thinly scattered amongst it; *but that part of the field that was unlimed, was nearly destitute of herbage, and covered with heath.*—*North Riding Report*, p. 209; *Derbyshire Report*, vol. ii. p. 436.

51 Statistical Account of Scotland, vol. vi. p. 530.—Parish of Forfar: also Hints as to the Agricultural State of the Netherlands, already alluded to. Part I. p. 72. The same idea occurred to Dr Beeke, that by means of fir plantations, the staple from the decaying vegetable matter might be so increased, that the most barren wastes might be rendered fit for corn.—*Berks Report*, p. 333.

It has been remarked, that lands, covered with fir, by nature, are not of much value for cultivation, but are in general of a barren rocky quality; and the improvement is only effected by *young* trees.

52 See the Rev. Mr Willis's valuable paper.—Communications to the Board of Agriculture, vol. vi. p. 17, and 23.

53 It is upon this principle that the Flemish acted, who have improved such an extent of waste land.—They never brought more barren soil into cultivation at a time, than they had *abundant* manure for.—*Communications to the Board of Agriculture*, vol. i. p. 225.

54 See vol. vii. Part i. p. 127; and Part ii. p. 244.—Three premiums of gold medals were voted by the Board for these exertions.

55 In a valuable account of the improvement of a tract of waste land, by Mr Simpson, upon the Pickering Moors, in Yorkshire, he observes, "That the great error into which many have fallen, is the ploughing out the tough mossy swards without paring and burning, which occasions an almost total failure of crop, and of course a want of manure for the next succession."—*North Riding Report*, p. 223; *Derbyshire Report*, vol. ii. p. 404.

56 In a moist climate, oats would probably answer better than rye.

57 Carrots might likewise have been tried.

58 Communications to the Board of Agriculture, vol. vii. p. 438.

59 Mr Smith of Swinridge-moor in Ayrshire has derived great credit, for having strongly recommended the application of lime to mossy soils, and having proved its efficacy.

60 They are described in the Galloway Report.

61 Preliminary Observations to the Westmoreland Report, by the late Dr Watson, Bishop of Llandaff, p. 8. General Report of Scotland, vol. ii. p. 388.

62 Mid-Lothian Report, Appendix, No. XI. p. 104.—Middlesex Report, p. 107; where the advantages of improving wastes, *in the neighbourhood of the metropolis*, are fully explained.

63 Caithness Report, Appendix, p. 141. Holt's Lancashire, p. 103.

64 Aberdeenshire Report, p. 221. In dry soils and in warm climates, the shelter of lofty trees is of no use, to protect the crops from the violence of the sun, and the evaporation it would otherwise occasion. This is found in the Netherlands, particularly in the Pays de Waes, and the same system might be useful in some parts of England.

65 Perthshire Report, p. 118.

66 Dr Skene Keith observes, that the difference between inclosures, and the bleak unsheltered lands in the same neighbourhood, is often from five to eight degrees of the thermometer.

67 General Report of Scotland, vol. ii. p. 276.

68 Middlesex Report, p. 137. 69 Ibid. p. 108. 70 Ibid.

71 Derbyshire Report, vol. ii. p. 259, 279; and vol. iii. p. 269.

72 Husbandry of Scotland, vol. i. p. 45.

73 Husbandry of Scotland, vol. i. p. 48. Derbyshire Report, vol. ii. p. 84.

74 In the Communications to the Board of Agriculture, vol. ii. p. 1, there is a very interesting Paper on Inclosures, by the late Robert Somerville, Esq., with engravings in no less a number than sixty-four modes of inclosure, some of them quite simple, and others more complex.

75 Kames's Gentleman Farmer, p. 269.

76 Middlesex Report, p. 135. Stone fences generally indicate a thin light soil, and, on such land, quickset hedges could hardly be raised as a fence.

77 Brown's Treatise on Rural Affairs, vol. ii. p. 297.

78 Husbandry of Scotland, vol. i. p. 447.—Where the wall is not built too open below, it is of great advantage, to introduce a little lime between each stone, along with the wedges or pins.—*General Report of Scotland*, vol. i. p. 307.

79 Communications from Sir George O. Paul, Bart.

80 There is reason to believe, that very useful plants might be obtained from America, for the purposes of inclosure.—The cockspur, or Newcastle thorn, produced and cultivated in the Delaware State, has a thorn, or pike, strong and sharp, from one and a half to three inches in length. The Virginia thorn, which makes an excellent fence, is a still more rapid and uniform grower, with an abundant armour of prickles, about an inch long, and remarkably sharp.—*American Farmer, June* 25. 1819. It would be extremely desirable, to have these plants tried, and compared with the European white thorn.

81 Kames's Gentleman Farmer, p. 272.—Husbandry of Scotland, vol. i. p. 47.—Derbyshire Report, vol. iii. p. 270.

82 Gentleman Farmer, p. 274.

83 Herefordshire Report, p. 50.—Marshall's Review of the Western Department, p. 322. Others think, that the old sets should be used only for filling up gaps, and for this purpose should be planted with good roots, and with careful digging below. They should also be left a foot and a half taller than the adjoining *stools* of the hedge, because they do not shoot so early.

84 Neill's Horticultural Tour in Flanders, &c. printed anno 1823, p. 204.

85 The Galloway form, two feet high, with a coping, or a rugged row of stones above the wall, would answer the purpose of protection sufficiently.

86 Stirlingshire Report, p. 123. This plan was adopted by a gentleman in Scotland, the late Mr Forbes of Callander, who planted six millions of thorns, and whose line of fences measured about four hundred miles in length. As the mound is narrow, and the ditches deep, there is a risk, that the rain water will run off, and not reach the roots of the thorns, in which case they must become stunted, owing to the want of an adequate supply of moisture.

87 Husbandry of Scotland, vol. i. p. 51. A long branch or stem must be half cut through, near the ground, fixed firmly in the surface by notched stakes, and covered with earth. The extreme end strikes root.

88 Communications to the Board of Agriculture, vol. ii. p. 14.

89 Marshall's Review of the Northern Department, p. 41.

90 General Report of Scotland, vol. i. p. 312.

91 See Blaikie's Tract on the Management of Hedges, p. 6.

92 General Report of Scotland, vol. i. p. 314. Blaikie on Hedges, p. 33, and 46. When strong stems are of necessity left high, they should be *notched*, that is, pieces of wood cut clean out of them about half through the stems. Young shoots push out immediately below those wounds; and by that means, the succeeding growth of the hedge is equalised, and the fence made more perfect. A hedge so cut, may afterwards be kept in good order by merely brushing upon the side shoots with a sharp scimeter hook, having a long handle.

93 Brown on Rural Affairs, vol. ii. p. 299.

94 Quicks have been found to answer well in middling soils, at nine inches asunder.

95 Husbandry of Scotland, vol. i. p. 50, note.

96 Brown's Rural Affairs, vol. ii. p. 300.

97 Kames's Gentleman Farmer, p. 273.

98 Communications to the Board of Agriculture, vol. ii. p. 42.

99 See Essay on Whin Hedges, by John Gordon, Esq. of Swiney.—Transactions of the Highland Society of Scotland, vol. iv. p. 341.

100 From the stiffness of its branches, it may grow well near the sea.

101 See Harte's Essay on Husbandry, p. 114; also Weston's Tracks on Practical Agriculture, second edition, p. 131; and opposite to p. 88, are plans of what he calls the Palisade Horn-beam hedge.

102 See a plan for that purpose in the Staffordshire Report, p. 43.

103 Mr Middleton states, that these objections to timber-trees in hedge-rows, might be in a great measure obviated, by keeping them closely pruned below the height of fifteen feet.

104 See Blaikie's Tract on the Management of Hedges, &c. p. 8, where there are a number of useful hints on the management of hedge-rows.

105 Observation by Mr Middleton.

106 Derbyshire Report, vol. ii. p. 92.

107 Husbandry of Scotland, vol. i. p. 51.

108 Remark by Isaac Leatham, Esq. in his Survey of the East Riding, p. 27. There is the plan of a new gate in the Farmer's Magazine, for May 1820, well adapted to straw yards, if not for fields.

109 Mr Fane of Oxfordshire finds the *split oak* superior to any other in point of duration, and not expensive.

110 General Report of Scotland, vol. i. p. 299, and 328.

111 Cheshire Report, p. 122.

112 Shropshire Report, p. 150.

113 Cheshire Report, p. 122.

114 Middlesex Report, p. 137.

115 In the year 1764, Elkington began to drain some fields on his farm of Princethorpe, which were so extremely wet, that it occasioned the rotting several hundreds of his sheep. He had dug a trench for that purpose about four or five feet deep, which did not however reach the *principal body of subjacent water*, from which the evil arose. *By accident*, while he was deliberating what was to be done, a servant was passing with an iron crow, or bar, for fixing sheep hurdles in an adjoining part of the farm. Having a suspicion that his drain was not deep enough, and desirous to know what sort of strata lay under it, he took the iron bar, and forced it down about four feet below the bottom of the trench. On pulling it out, to his astonishment, a great quantity of water burst up through the hole thus made, and ran along the drain. This led him to the knowledge, that wetness may often be produced by water, confined farther below the surface of the ground, than it was possible for the usual depth of drains to reach, and that an auger would be an useful instrument to apply in such cases. From his success in this, as well as other modes of draining, and the readiness with which he communicated the principles on which his operations were conducted, to the Board of Agriculture, the British Parliament granted him a reward of one thousand pounds. He taught his art to Mr Johnstone, who has drawn up a valuable treatise on the subject, from which much assistance has been derived in preparing this Section. It is singular, that another great modern improvement, *warping*, was likewise discovered by an accident. (See Sect. 10.)

116 There are instances in Cheshire and Roxburghshire, of lime being applied to a wet soil, without any visible effect; but no sooner was it drained, even some years after, than, without any additional quantity of calcareous matter, it produced luxuriant crops.

117 Too much moisture in the soil, may prevent springing, for the seed cannot contend with moisture, till it gets green leaves. If there is any risk of wet, the field should be water-furrowed, after the seed is sown.

118 In the southern districts of Scotland, particularly in the counties of Berwick, Roxburgh, Selkirk, and Peebles, most of the principal sheep farms have been very much drained, and the consequence is, that the size, quality, and healthiness of the stock in these districts, have been thereby so much improved, as appears almost incredible to those who were acquainted with the former state of sheep-farming in those parts. In many of these farms the rent has increased fourfold, and the rot is now hardly known.

119 Middlesex Report, p. 288.

120 Oxfordshire Report, p. 231. Derbyshire Report, vol. iii. p. 621.

121 Forfarshire Report, p. 73.

122 They must be scoured annually.

123 General Report of Scotland, vol. ii. p. 437.

124 Husbandry of Scotland, vol. i. p. 61.

125 Young's Calendar, p. 45, 86, 160, 220, 459, and 468. Too much attention cannot be paid to water-furrowing strong land.

126 General Report of Scotland, vol. ii. p. 462.

127 Worcestershire Report, p. 191.

128 General Report of Scotland, vol. ii. p. 450.

129 Leatham's East Riding Report, p. 22.

130 General Report of Scotland, vol. ii. p. 499. In the border districts, they consider March, to be the best period of the year for determining the proper line of a drain. In that month, if it be dry, the distinction between the naturally wet and dry parts of a ploughed field, is more palpable than at any other season of the year. In that month, accordingly, it is the practice in the border counties, both to mark out, and to work, the drains, while the land is under preparation for turnips. But the same plan would not be equally suitable to wet and heavy soils.

131 Young's Calendar, p. 30.

132 Essex Report, vol. ii. p. 169.

133 They are made by digging a trench of a proper width, not less than three feet deep, and if the last spit is taken out by the narrow under-draining spade, a shoulder is left on each side, upon which a sod or turf is laid, grass-side downwards, and the mould thrown in over it. These are the least expensive drains of any, and may continue hollow, and discharge well, for many years.

134 A drain is dug to the necessary depth, as narrow as possible, in which is laid a smooth round piece of wood, ten or twelve feet long, five inches in diameter at one end, and six at the other, to which a ring and rope are fastened. After strewing a little sand in the bottom of the drain, and on the upper side of the tree, the toughest part of the stuff thrown out of the trench, is first laid in upon it, and then the remainder firmly trodden down. By means of the ring and rope, the tree is drawn to within a foot or two of the small, or hinder end, and the same operation is repeated. Such a piece of wood dragged along water-furrows, would be of much use in giving a proper shape. This may convey water from a spring through a field, to an outlet; but if the pipe is formed of clay, no water can get through that clay, into the conduit, in its course.

135 Marshall, in his Midland Counties, vol. i. p. 139, gives a particular detail of *turf-draining*, which he greatly prefers to the Essex method of *bush-draining*, by which the drain is filled with perishable materials.

136 Middlesex Report, p. 292.

137 Essex Report, vol. ii. p. 169.

138 Derbyshire Report, vol. ii. p. 397.

139 Marshall on Landed Property, p. 107.

140 This plant, (the *equisetum palustre*), was first noticed by Mr Farey, in the drains near Woburn Abbey. A description of it is given by Sir Joseph Banks, in the Communications to the Board of Agriculture, vol. ii. p. 349. It belongs to the genus "*Conferva*."

141 Marshall on Landed Property, p. 98.

142 Brown's Treatise on Rural Improvements, vol. ii. p. 256.

143 General Report of Scotland, vol. ii. p. 457.

144 Holt's Lancashire, p. 33, and p. 107.

145 Middlesex Report, p. 289.

146 Young's Calendar, p. 35.

147 The apparatus is described in Rudge's Gloucestershire, p. 261.

148 Leatham's East Riding Report, p. 30.

149 In fen countries, called a "*Hodding spade*," from its use in digging peats for firing. These, of a certain size and shape, are called "*Hods*."

150 There is a particular description of this process, with engravings, in the General Report of Scotland, vol. ii. p. 492. See also Derbyshire Report, vol. i. p. 318.

149 Hints on the Agricultural State of the Netherlands, p. 73.

150 Young's Lecture on the Husbandry of three celebrated British farmers, p. 18.—It was Arbuthnot who first discovered the merits of the Southdown breed, now held in such high estimation.

151 Husbandry of Scotland, vol. i. p. 56.

152 Derbyshire Report, vol. ii. p. 494.

153 Gloucestershire Report, p. 263.

154 Northumberland Report, p. 128.

155 General Report of Scotland, vol. ii. p. 446.

156 The expense varies in different cases, from three farthings to six farthings per rod of six ells. There is a person near Peebles, who will contract for executing such works, and will give in an estimate of the expense.

157 The borings and pits made and sunk by colliers, in various parts of Great Britain, had the same effect.—*Derbyshire Report*, vol. i. p. 501. But till the time of Elkington, boring never was made use of in making drains.

158 General Report of Scotland, vol. ii. p. 456.

159 Derbyshire Report, vol. ii. p. 361, and 382.

160 It is not unusual to divide the business of draining between the landlord and the tenant. By the former the drains are made in a proper direction, and of a proper depth, while the tenant bears half the expense of procuring the stones, leading them, and placing them in the ditch. The landlord should appoint the men to put in the stones, and to fill up the earth.

161 A real statesman should always keep this maxim in view, " That laws ought to change with the circumstances of a country; and above all, that the same system, which might be calculated to govern and to secure the sustenance of six millions of inhabitants, will not answer equally well when the population has increased to twelve millions, or upwards." The changes, however, should be gradual, and at a proper season. If they are too long pertinaciously resisted, the evil increases, too many alterations must be made at once, and the changes are then attended with the hazards of convulsion.

162 Coventry's Discourses, p. 37.

163 Report of the Agriculture of Hertfordshire, by Arthur Young, Esq. p. 40.

164 A particular detail of the process by which this manure is prepared, is given in a work written by Le B. E. V. B. Crud Economie de l'Agriculture, printed at Paris and Geneva, in one vol. 4to. See p. 350, No. 289. In some parts of Germany, the same process is adopted, under the name of *Gülle*.

165 Called *putrescent*, being liable to natural decomposition or decay.

166 In some experiments made at Great Ponton, near Grantham, on a poor dry soil, the manure from a horse-yard, and that from a yard where neat cattle were wintered, were used separately for turnips; the former had greatly the advantage. It would have been right to have tried the effect of a mixture of the two.

167 The propriety of this mixture of the dung of various animals, is very ably enforced by Mr Blaikie, in his short tract, " On the Economy of Farm-yard Manure, and on other Rural Subjects," p. 3, &c. &c.

168 Middlesex Report, p. 305.

169 Brown's Treatise on Rural Improvements, vol. i. p. 367, 368.

170 Communication from Mr Dudgeon of Prora, in East Lothian, of an experiment made in 1814. Mr Brown of Markle states, that if straw were simply to be rotted by moisture from the heavens, the original weight would be thereby doubled; but when rotted by the urine and dung of turnip-fed stock, there can be no doubt, but that for every ton of straw carried to the fold-yard, four tons of dung will be carried to the field, provided the manufacturing process has been properly conducted.

171 Mr Arthur Young's Essay on Manures, p. 153. This valuable Treatise is contained in the 10th volume of the Papers of the Bath Society.

172 This liquid might likewise be conveyed in water-carts to the fields, and applied by means of a gardener's watering pot, to fresh planted cabbages, or savoys, and on some occasions to the potatoe-crop, or to meadow land. This is constantly practised by several intelligent farmers.—*Communication from John Middleton, Esq.*

173 Marshall on Landed Property, p. 168. This author recommends, that the reservoir should be furnished from time to time, with a flooring of good mould, to absorb the sediment which the liquor will let fall. See also an account of a tank at Bradby Park, Derbyshire Report, vol. ii. p. 454.

174 Young on Manures, p. 158.

175 Middlesex Report, p. 300.

176 Mr Roberts of King's Walden, would always carry *stable dung*, long and fresh, to the land; but he thinks that *farm-yard manure* should be turned up once, yet not kept too long.—See Young's Essay on Manures, p. 146. Mr Wilkes also speaks of dung taken from *the stable-yard*.—Ditto, p. 148. An intelligent farmer recommends *half-rotted* litter.

177 This was the plan of that distinguished agriculturist, Mr Curwen, of Workington Hall in Cumberland, whose farm produces, on an average, 10,500 single-horse carts of manure per annum. Such a quantity of dung could not be managed on any other system.

178 Blaikie on Farm-yard Manure, p. 13.

179 Blaikie on Farm-yard Manure, p. 15; where the process is more minutely described. The dung thus prepared, gets into a fine condition, being at once heavy, short, and mellow. Dr Rigby's Report, p. 56. By this improved method of preparing dung, Mr Coke has saved L.500 per annum in the price of oil-cakes, and his crops of turnips are good, if not better, than before.

180 When used in this way for turnips, the dung should be made as moist as possible, to promote a rapid vegetation. In cultivating carrots and parsnips, the dung ought to be thoroughly reduced, and *placed deep in the ground*, so that the roots shall not reach it, otherwise they become forked, or divide.

181 Brown's Treatise on Rural Affairs, vol. ii. p. 384.

182 General Report of Scotland, vol. ii. p. 518.

183 This is particularly necessary, when applied to a crop of barley, the ripening of which, ought as much as possible to be simultaneous.

184 It may be proper to add in a note, that a zealous friend to agriculture, (John Fane, Esq. Member for Oxfordshire), manures about 26 acres yearly, with the dung of rabbits, kept solely for that purpose. The skins and carcasses pay the expense, and the manure is all clear profit.—*Oxfordshire Report*, p. 316. But the plan could not be carried to any great extent, as there would not be a market for the carcasses.

185 This plan is particularly described in the General Report of Scotland, vol. ii. p. 511, on the authority of Mr Hunter of Tynefield.

186 Sir Humphry Davy's Lectures, p. 259.

187 The city of Aberdeen, containing about 30,000 inhabitants, lets its dung for L.1500 per annum, or 1s. per head. At that low rate, the whole city of London ought to receive above L.30,000 per annum for its street dung. *The street dung* alone of Edinburgh, was lately let for L.2000 per annum. In Derbyshire, particular attention is paid to town dung.—*Report*, vol. ii. p. 453.

188 Middlesex Report, p. 301.

189 Young's Essay on Manures, p. 168.

190 Middlesex Report, p. 301, note.

191 Sir Humphry Davy's Lectures, p. 255. This manure is made into cakes, at Paris, under the name of *poudrets*, and is found of the utmost advantage, particularly on strong lands. Mr Joseph Clarke of Goswell Street prepares an article somewhat similar in London. It appears highly probable, that much advantage might be derived from the addition of quick lime, both by accelera-

ting the desiccation, or by forming a chemical compound, as phosphate of lime, so important to the growth of wheat.

192 Sir Humphry Davy's Lectures, p. 257. M. Cazeneuve, from Paris, by means of his "*mobiles inodores*," proposes to separate the urine from the night soil, which would prevent the fœtid effluvium produced by fermentation. This would render the use of such manures less objectionable.

193 Hints on the Agricultural State of the Netherlands, p. 63.

194 If bones or sea-shells are properly sprinkled with putrid urine, it excites such a fermentation, as to dissolve them, and thus a manure is formed, much more valuable, and more speedily efficacious.

195 Communication from John Middleton, Esq.

196 Curwen's Report, p. 61.

197 Sir Humphry Davy's Lectures, p. 251. 198 Ibid. p. 251.

199 The effects of woollen and leather rags on chalky soils, are said to be peculiarly striking.

200 Ten bushels of old feathers, have added two quarters to the produce of an acre of wheat.—*Lincolnshire Report*, p. 143.

201 Sprats are frequently applied as manure to the hop gardens, along the borders of the river Medway in Kent; and they produce great effects, though only for one year.—*Communication from John Middleton, Esq.*—See Report of Cornwall, as to the effect of fish on grass lands. In the county of Galway, in Ireland, fish manure has been found highly advantageous. In Scotland, it is calculated, that fourteen barrels of herrings, will yield one barrel of refuse, or garbage, two barrels of which will be a single horse cart load. Sixteen load of this manure, the produce of eighty-four barrels of herrings, when mixed with forty-eight loads of earth, will manure an acre of land. If 300,000 barrels of herrings, therefore, are caught in Scotland in one year, the garbage would be sufficient to manure about 3600 acres of land per annum.—*Communication from William Young, Esq. of Inverugie.*

202 The use of oil, in vegetation also, is very great. When the cuttings of gooseberries are planted, it should be done in a lump of clay mixed with cow-dung, and a few drops of train oil; and, when young thorns are planted in a poor or sandy soil, they will thrive better, if their roots are dipped in oil. Near the first turnpike going to Milend, there is an artificial manure sold, supposed to be the sweepings of the drysalters in Thames Street, mixed with the refuse of those places where the blubber of whales is boiled, one bushel of which, it is said, is equal to twenty-eight of common manure.

203 Northumberland Report, p. 134.

204 Husbandry of Scotland, vol. i. p. 170. Even the cover of limestone quarries has been usefully applied to heath, to rough stunted grass lands, and to meadow grounds.

205 Westmoreland Report, p. 235.—Lime is supposed not to increase the quantity of grass, though it improves its quality. It certainly renders the herbage more nutritious, whether as hay or pasture, and preserves the stock, sheep in particular, from some disorders.

206 Northumberland Report, p. 131.

207 Somerset Report, p. 512.

208 Derbyshire Report, vol. ii. p. 38, 401, &c.

209 Herefordshire Report, p. 57.

210 Husbandry of Scotland, vol. i. p. 170.

211 Husbandry of Scotland, vol. i. p. 186.—Lime has been successfully employed in the south of Scotland, to destroy the texture of that moorish subsoil, which is so unfavourable to vegetation.

212 Remark by Edward Burroughs, Esq.

213 From inattention to this rule, much money has been uselessly expended, and many have been led to doubt the efficacy of lime, because they employed a sort of inferior quality.

214 Magnesian limestones are generally coloured brown, or a pale yellow. They are found in Yorkshire, (near Doncaster), in Somersetshire, and various parts of England; and near Belfast in Ireland. What a treasure for improving the bogs of Ireland, for the application of this lime is probably the cheapest and most effectual mode of improving peaty soils. See Sir Humphry Davy's Lectures, p. 281; and Derbyshire Report, vol. ii. p. 409, &c. Magnesian limestone re-absorbs carbonic acid gas much more slowly than other sorts of lime, and magnesia, when deprived of its carbonic acid gas by burning, is directly injurious to vegetation. Not only, therefore, does that species of limestone remain longer in the state of quick lime, (in which state, it not only burns vegetable matter, and destroys its texture, dissipating all but its more solid parts, without the putrefactive process taking place), but it continues for a long time, to contain a principle within it, injurious to the growth of the plants to which it is applied.

215 Nine-tenths of the lime used in Ireland is burnt with peat. See Mr Dutton's Letter, in the Farmer's Journal, Oct. 2. 1820.

216 Slacked lime is merely a combination of lime, with one-third water.—*Sir Humphry Davy's Lectures*, p. 277. It has been remarked, that the whiter the powder, the better is the lime in quality, for every thing that discolours it is not lime.

217 Husbandry of Scotland, vol. i. p. 212.—Derbyshire Report, vol. ii. p. 438 to 445.

218 The grubber, or scarifier, would answer this purpose effectually. No more should be spread at a time, than can be immediately mixed with the soil. It should not be spread on a windy day, for servants cannot judge so well of its equal distribution, nor perform it so well. But a gentle breeze is rather useful than otherwise.

219 Communications to the Board of Agriculture, vol. iii. p. 231.—A previous application of two years, is in general considered to be sufficient.

220 The late Mr Barclay of Ury, often gave from 500 to 600 bushels of calcined lime per Scotch acre, or from 400 to 430 bushels per English acre; but when he gave such great quantities, he never limed a second time, except merely to give a slight top-dressing, when grass-seeds were sown.

221 A new mode of application has lately been thought of in Cumberland. It is, after the first cutting of clover, to spread immediately on the ground, from 30 to 40 bushels of *hot lime*, per statute acre. This produces a great increase from the second cutting, greatly improves the value of the next year's grazing, and the succeeding crop of oats.—*Curwen's Report*, p. 24, and 42.

222 Husbandry of Scotland, vol. i. p. 184; General Report of Scotland, vol. ii. p. 586.

223 Dr Fenwick of Durham. It is a short Essay, entitled, "Reflections "on Calcareous Manures," which the Doctor read to the Literary and Philosophical Society of Newcastle-upon-Tyne, and which was printed at their request, but has not been published.

224 At Holkham, oyster-shells are broken to pieces, either by passing them through oil-cake crushers, or repeatedly drawing a heavy iron roller over them, when spread upon a stone, or hard-burned brick-on-edge floor. A mill for crushing bark would answer the same purpose. Anno 1816, 40 bushels of this manure were drilled in the usual way, upon 27 inch ridges, slightly covered with earth, and the turnip-seed sown upon it. In the same field, turnips were sown, on ridges of the same size, manured with farm-yard dung, at the rate of 8 tons per acre. The turnips were a good crop on both pieces; no difference perceptible. The succeeding crop of barley, and the crop of clover afterwards, to all appearance, were equally good on both. Powdered shell manure was likewise tried, anno 1816 and 1817, in competition with powdered rape-cake, as a manure for wheat, partly drilled with the seed when sown, and

partly applied in spring, drilled between the rows of wheat, and there was no perceptible difference in the produce, between the land manured with the shell-powder, or with the powdered rape-cake.

225 A curious circumstance is mentioned by the same author, which he ingeniously accounts for. A quantity of very mild lime was laid in a heap, where it remained for some time, and when it was removed, the spot was covered with white clover. A heap of hot lime was left for the same space of time, no vegetation took place for a considerable period, and the spot was at length covered with couch grass. Neither the clover nor the couch-grass could be produced by the heaps of lime, but the circumstance is thus accounted for: The hot lime retained its causticity much longer, and in that state, destroyed any seeds contained in the soil; but the couch grass being less easily destroyed, or shooting and spreading from the neighbouring land, soon took possession of the vacant spot. In regard to the clover's following the mild lime, there is nothing singular, as its seed is very generally diffused, and always vegetates in a calcareous soil.

226 Perthshire Report, p. 283.

227 Remark by Edward Burroughs, Esq.

228 A ridge of irregular hillocks run across the parish, which consist of large sand, or rather gravel. This gravel has of late been used with great success, as a manure for the land in the neighbourhood. Its excellency was discovered about twenty or twenty-five years ago, (that is, about the year 1770, the account being dated 1793). They use this gravel for repairing the highway between Aberdeen and Peterhead; and some years after, they were surprised to see fine white clover, growing very thick on those places of the road, which had been repaired with this gravel, and every other place as bare as ever. This induced them to try the gravel as a manure, which they continue to use, and find it uncommonly rich and durable.—*Statistical Account of Scotland, (Parish of Slains)*, vol. v. p. 280.

229 Hence straw, for hats, and similar manufactures, is found in the greatest perfection in the neighbourhood of Dunstable, Luton, and other places in the Chiltern range of hills. It is probable, that the *silex* which the soil in these districts contains, produces this effect.

230 Communication from John Middleton, Esq.

231 On the other hand, many valuable pits of water have been obtained, by taking out clay-marl for the sandy lands in Norfolk.

232 See Marshall's Review of the Northern Departments, p. 287, &c. where the information contained in the Lancashire Report upon this subject is very ably analyzed. In many parts of Derbyshire and Cheshire, there are the vestiges of ancient marl pits, though the practice of marling is now almost forgotten by the inhabitants.—*Derbyshire Report*, vol. i. p. 148, 456; and vol. ii. p. 407.—Surface-draining, properly conducted, might restore to these lands, their former capability of profiting from the treasure of red marl existing below them. As burnt clay is attended with such beneficial effects, burning rock, slate, or clay marl, would be still more beneficial, and has been partially tried in Lancashire.

233 North Riding Report, p. 238; East Riding Report, p. 55.

234 Near Falmouth, 50 in 100 parts of the article consist of broken coral; but in Cornwall, from 70 to 80 parts in 100 consist of broken shells. The farmers prefer taking it as near low-water mark as possible. They thus obtain a small quantity of saline matter, (perhaps from 3 to 4 or 5 lbs.), but the advantages of this calcareous substance as a manure are, that it thickens, or deepens the staple of the soil;—that some parts of the calcareous matter, where it is required, enter into the composition of the plant;—that it loosens the earth, and rendering the soil more friable, enables the plant to take a greater range in quest of food;—and that being an absorbent of acids, it is a corrector of the soil.—*Communication from the Rev. Robert Hoblyn.*

235 Near Falmouth, 50 in 100 parts of what is called shelly sand, consist of broken coral. In Cornwall, on the other hand, from 70 to 80 parts in 100 consist of broken shells. The farmers prefer taking it as near low-water mark as possible, for thus they obtain a small quantity of saline matter, (perhaps from 3 to 4 or 5 lbs.)

The advantages of these calcareous substances as a manure are, 1. That it thickens, or deepens the staple of the soil; 2. That some parts of the calcareous matter, where it is required, enters into the composition of the plant; and, 3. That it loosens the earth, and rendering it more friable, the plant is thence enabled to take a greater range in quest of food.—*Communication from the Rev. Robert Hoblyn.*

236 Statistical Account of Scotland, vol. iii. p. 367.

237 It is certain, that in several cases soapers' waste has been found of use; but it is said to have been extensively tried in Surrey and Kent, upon both old meadows, and arable land, of the stronger kind, without its producing any beneficial effect. Perhaps it was applied in too small quantities.

238 Sir Humphry Davy's Lectures, p. 287. The indifferent success which has attended the trials of gypsum in Derbyshire, where this substance is dug in large quantities, may be owing to its being burnt. Mr Farey therefore, recommends trying it ground, or in powder, as practised in America, and on the Continent of Europe. *Derbyshire Report,* vol. ii. p. 448.—This substance unburnt, was tried at Holkham, in 1819, for clover and sainfoin, and six bushels of the powder were used per acre, with prodigious effect.

239 Second Report from the Committee on the State of Disease in Ireland. Printed by the House of Commons, 7th July 1819. Appendix, p. 139.

240 Young's Essay on Manures, p. 126.

241 Cheshire Report, p. 22.

242 In a letter published in the Farmer's Journal of the 13. Dec. 1819, signed John Day, the use of *clay ashes* is much recommended, as calculated at some future period, to double the value of all the strong clay soils in the United Kingdom, by exchanging them from a tenacious clay, to a friable garden mould.

243 Remark by Edward Burroughs, Esq. a most intelligent agriculturist in Ireland.

244 See Mr Dutton's Letter in the Farmer's Journal, Oct. 2. 1820.

245 General Report of Scotland, vol. ii. p. 530. This may arise from its being so strongly impregnated with saline matters. It is desirable, however, to have the mud applied as manure, fermented with dung, to destroy all vegetative powers in the roots, or in the seeds of weeds which the mud might contain.

246 As tracts of wood. Derbyshire Report, vol. iii. p. 187, 448.

247 Young's Essay on Manures, p. 1160.

248 General Report of Scotland, vol. ii. p. 544. Derbyshire Report, vol. ii. p. 445.

249 Communication from Mr Farey.

250 The late Duke of Richmond found lime and sea-weed a most excellent compost. He mixed six waggon loads of sea-weed, with one load of lime shells, in a heap 18 feet long and 10 feet wide, in the beginning of August, and in the September following, the compost was carried to the land, turned over three times, and used as a top-dressing in October, when the wheat was sown. The crop exceeded five quarters per acre. The compost had the appearance of earth and lime mixed together, with some streaks of white, which were very salt. The bulk was reduced one-third.

251 General Report of Scotland, vol. ii. p. 528. Beans and pease thrive well, in a dry season, with ware as a manure; and it is used in East Lothian for a potatoe crop, with decided benefit.

252 Forfarshire Report, p. 416.

253 Roxburghshire Report, p. 142.

254 Young's Essay on Manures, p. 182.—In Herefordshire, the pulp of pears and apples, after the liquor is extracted from them, mixed with quick-lime, and turned over two or three times the succeeding summer, is converted into a good manure.—*Report*, p. 88.

255 Curwen's Report, p. 66.

256 Hints on the Agricultural State of the Netherlands, p. 12.

257 Sir Humphry Davy's Lectures, p. 247.

258 In the Appendix, some interesting experiments on this subject will be detailed, from the Communications of Edward Burroughs, Esq.

259 Lincolnshire Report, p. 265. Perhaps vetches, rape, or clover, would have answered better than buck-wheat.

260 The practice of ploughing in, is strongly objected to by Lord Kames. —*Gentleman Farmer*, p. 358.

261 Young's Essay on Manures, p. 176.

262 Hints on the Agricultural State of the Netherlands, p. 34. These ashes, when analyzed, are said to yield 12½ per cent. of gypsum, which sufficiently accounts for producing such effects on the clover crops.

263 In the publications of the Highland Society, an account of several successful experiments will be found, but not so decisive as could be wished.

264 Communication from J. Attersoll, Esq.

265 Communications to the Board of Agriculture, vol. iv. p. 370.—In large quantities, soot and salt are of so acrid a nature, that no species of grain will grow within the sphere of the full exertion of their powers.—*Remark by the Rev. Robert Hoblyn.*

266 Mr Middleton is of opinion, that this compost would occasion unnecessary expense, and recommends the following plan as preferable: sow the soot upon the land, and harrow it in; there it will have a sufficient quantity of earth; and some time afterwards, lime the same soil, and harrow that in. The effect will be the same, as would be produced by the proposed compost, and the benefit would be obtained at much less expense.

267 General Report of Scotland, vol. ii. p. 543. The truth is, that any addition to soot, and making it into compost, can only be, for the purpose of more certain distribution, and to prevent waste by blowing. To save that expense, soot may be sown unmixed, in rainy weather, over the crop when young.

268 Renfrewshire Report, p. 135.

269 Mr Curwen, of Workington-hall, manures 20 acres per annum, with this neglected rubbish.

270 Derbyshire Report, vol. ii. p. 414.

271 A considerable extent of waste land was improved by Mr Bruce of Grange-muir, in Fife, North Britain, by a compound of moss and lime, which merits particular notice. He mixed 1200 tons of peat earth, more than half dry, with 280 tons of lime. The mixture stood seven weeks. The temperature rose from 56 to 87. It was then turned over, and stood three weeks longer. It was applied, *anno* 1808, to 32 Scotch (about 38 English) acres. The first crop was wheat, ten Lothian bolls, or 32 Winchester bushels per Scotch acre. Rye-grass and clover, sown with the wheat, produced a heavy crop, followed by an excellent crop of oats. The land has ever since been in good order. The soil was partly clayey, and partly loamy. Was never before cultivated. It was fast fallowed, drained, and cleared of stones. The compost was applied before the last ploughing for wheat.

272 Young's Calendar, p. 97. A rich compost may be thus made: mix saw-dust with bullock's blood; add two waggon-loads of this mixture, to three waggon-loads of common mould or earth. This will be quite sufficient for an acre of wheat, applied as a top-dressing.

273 Peat-bogs are confined to narrow districts in Italy, and were long considered as useless wastes. But in 1765, Count Fabio Asquini of Fayagna, in

the province of Friuli, in the Venetian territories, began to use peat by way of compost.—*Professor Symmonds's Account of the Agriculture of Italy*, Annals of Agriculture, vol. iii. p. 25.

274 Lord Meadowbank likewise tried the mixture of animal matter, as fish-refuse, whale-blubber, &c. with much success. It is evident, that peat would be an excellent substance in a compost heap, intended for sandy or chalky soils, as it would not only add to them a portion of vegetable matter, but would materially assist in giving them a deeper shade when blended with the soil.—*Remark by Edward Burroughs, Esq.*

275 Westmoreland Report, p. 324.

276 General Report of Scotland, vol. ii. p. 358.

277 Ibid. vol. ii. p. 551.

278 Remark by the Rev. Robert Hoblyn.

279 The late Dr Fordyce drew up a plan for that purpose, which will be found in the General Report of Scotland, Appendix, vol. ii. p. 124. It may be proper here to remark, that Mr Grisenthwaite, an ingenious chemist, of Wells in Norfolk, undertook to discuss the subject of *specific manures*. The theory has taken its rise from the analysis of clover, sainfoin, &c. and the advantage of gypsum to those crops. It is inferred, that by analysis, other specific manures may be applied to other crops. Thus, wheat yields, by analysis, *phosphate of lime*, and a peculiar substance called gluten, of which nitrogen is a constituent. Hence urine, (by folding, for instance), and bone manure, in powder, are found highly useful. How much farther the science will advance, is uncertain.

280 Suffolk Report, p. 182.

281 Dr Rennie, who has paid peculiar and successful attention to the subject of peat-mosses, considers those which are highly bituminated and pyritous, also ferruginous soils, with a yellow or red tinge, as unfit for the operations of paring and burning; but these form merely exceptions to a general rule.

282 Middlesex Report, p. 294, note; Derbyshire Report, vol. ii. p. 401, and 403. The necessity of continuing the paring and burning system, on a fenny soil, is confirmed by the experience of the fenny districts.

283 Middlesex Report, p. 294, note. 284 Ditto, p. 295, note.

285 Middlesex Report, p. 296. Mr Simpson's experiments, (North Riding Report, p. 207), are decisive upon this point.

286 Boys's Treatise on Paring and Burning, annexed to the Kent Report, second edition, p. 272.

287 Communication from John Middleton, Esq.

288 North Riding Report, p. 228.—See another instance in the Lincoln Report, p. 292.

289 Northumberland Report, p. 126.

290 Sir Humphry Davy's Lectures, p. 307.

291 Young's Essay on Manures, p. 131.

292 Sir Humphry Davy's Lectures, p. 305.—Middlesex Report, p. 299. —See also Kent Report, p. 291.

293 In many parts of England, paring and burning is called *Denshiring*, said to be a corruption of *Devonshiring*, in allusion to the early and very general practice of it in that district.

294 Marshall's West of England, vol. i. p. 151.—A more enlightened system of husbandry seems now to be gaining ground in these two counties; and the soil is expected to yield its fair produce, without the compulsive sacrifice of its most valuable materials to avarice, or to ignorance.—*Remarks by the Rev. Robert Hoblyn.*

295 Remark by Edward Burroughs, Esq.

296 Young's Calendar, p. 622.

297 Boys's Treatise in the Kent Report, p. 54.

298 Boys's Treatise in the Kent Report, p. 258.

299 Vol. v. p. 5.

300 Kent Report, p. 243.

301 Leicestershire Report, p. 185.

302 Boys's Treatise, p. 256. It is on this principle that clay burned in kilns, is considered a superior manure to clay reduced to ashes.

303 This is frequently done in the fens, but the ashes are not thought so good, and in fact it can only be done when the turf is very grassy, and cut thin. It is considered, however, more useful than the condensed mode.

304 Middlesex Report, p. 370.

305 The effect of heat, in the operation of paring and burning, is remarkable. Wherever burning has been much practised, experience has demonstrated the necessity of removing all the ashes where the fires were made; and though careful farmers remove some of the unburnt earth, still these spots manifest a deeper green in the crop, than is observable in any other part of the field. The *general* warmth diffused may probably have a greater effect than is commonly suspected.—*Young's Essay on Manures*, p. 131.

306 In some parts of Devonshire, the soil is so tender, that it can be breast-ploughed for 9*s.* per acre, and the burning and spreading the ashes cost only 6*s.* 6*d.* more. *Devon Report*, p. 151.—Such lands ought never to be burnt, unless the grass be very old.

307 Kent Report, p. 259, 260.

308 See Dr Rennie's valuable Section on Paring and Burning, General Report of Scotland, vol. ii. p. 412.

309 Young's Calendar, p. 74, 380, and 421.

310 Lincoln Report, p. 295.

311 Kent Report, p. 250.

312 Communication from John Naismith, Esq.

313 Kent Report, p. 249.

314 Kirwan on Manures, p. 89.

315 Where Mr Ellison, of Sudbrook in Lincolnshire, spread the ashes as burnt, he had a luxuriant crop.—*Lincoln Report*, p. 293.

316 Young's Essay on Manures, p. 135.

317 General Report of Scotland, vol. ii. p. 416.—In North Wales, the ashes of pared sods burnt in June, are frequently left in heaps, without being spread, until seed time, in September or October, when rye is sown.—*Report*, p. 293. See also Derbyshire Report, vol. ii. p. 403.

318 Though the produce of pease may be increased by liming or marling, yet the boiling property is thereby often destroyed.—*Derbyshire Report*, vol. ii. p. 132.

319 Kent Report, p. 292.

320 On moist-bottomed lands, rape will often succeed better than turnips; and sheep feed better with rape on such lands.—*Suffolk Report*, p. 1[illegible]5, note. In Derbyshire they prefer turnips.—*Report*, vol. ii. p. 403.

321 Kent Report, p. 261.

322 Kent Report, p. 293.

323 General Report of Scotland, vol. ii. p. 413.

324 A second crop of grass will often be necessary, even on such soils, where they are of inferior quality; and in some districts, oats must be sown instead of wheat.

325 Kent Report, p. 261.

326 Communication from John Middleton, Esq.

327 Suffolk Report, p. 183, note.

328 Northumberland Report, p. 126.

329 Derbyshire Report, vol. ii. p. 406.

330 Gloucestershire Report, p. 255.

331 In new inclosures, where furze and heath abound, paring and burning is absolutely necessary, for these plants cannot be destroyed, even by good husban-

dry, in any fixed period. On a new inclosure of some land in South Mimms, that had been laid down to grass, after seven years' cultivation, they again appeared in such numbers, that it was necessary to plough the land up again, which would not have been necessary, had the land been pared and burnt.—*Middlesex Report*, p. 300, note.

332 Middlesex Report, p. 247. 333 Ditto, p. 297.

334 The Marquis of Tourbilly asserts, that one-half of the seed requisite in other soils, will serve on land that has been burnt, and that the crop is uniformly a month earlier than on the adjacent lands; but neither of these advantages has been experienced in this country.

335 Kirwan on Manures.—Trans. of the Irish Academy, vol. v. p. 195.

336 Northumberland Report, p. 129.

337 Kent Report, p. 284.

338 Middlesex Report, p. 295.

339 Young's Calendar, p. 171. An intelligent agriculturist, (the Rev. Robert Hoblyn), maintains, that the burning the roots of vegetables, to *black ashes*, does little mischief; but that the burning the soil to *red ashes*, induces great future sterility. But where the staple is of an adequate depth, a portion of the soil may be advantageously reduced to ashes by the process of burning.

340 Sir Humphry Davy's Lectures, p. 301.

341 Mr Kent, in his Norfolk Report, stated his sentiments in a section, entitled, " Fallowing exploded," which was ably answered by Mr Brown, in the West Riding Report, under the title of " Fallowing defended."

342 At what intervals the operation should be repeated, will be explained in the Section " On the Rotation of Crops."

343 The expenses of trenching, in Flanders, are calculated as follows: 1. Light lands, *eighteen inches deep*, L.1, 6*s.* per acre; 2. Strong land, *eighteen inches deep*, L.1 : 11 : 2 per acre; 3. Strong land, *two feet deep*, L.2, 5*s.* per acre. In those parts of England, where men are to be found accustomed to dig, light land would be trenched at 3*d.* per perch, or 40*s.* per statute acre; and even strong land, at the rate of 4*d.* per perch, or 50*s.* per acre.

344 In the Appendix, No. VIII, there is a detailed account of the expense of fallowing, on the improved system of the Lothians, from which it appears, that the expense is greatly diminished by the use of the scarifier or grubber. In England, the fallow ploughing is seldom begun so early as it ought to be, nor is cross-ploughing attended to, without which the process is imperfectly done. The ploughings should also be carried on in the dry seasons, being better calculated for the destruction *of root weeds.*

345 Marshall's Gloucestershire, vol. i. p. 72.

346 Marshall's Southern Counties, vol. i. p. 95.

347 Kent Report, p. 69.

348 Young's Essex, vol. i. p. 201, and 205. In Essex they sometimes plough eight times for a fallow.

349 Young's Norfolk, p. 192.

350 Staffordshire Report, p. 50.

351 Derbyshire Report, vol. ii. p. 102.

352 Curwen's Report, p. 59.

353 Suffolk Report, p. 51.

354 Marshall's Gloucestershire, vol. i. p. 75.

355 Winter tares, unfortunately, are apt to be destroyed by hares and rabbits, being their favourite food; and they run great risks where these vermin abound.

356 For a detail of Mr Middleton's system, and his statements in proof of the superiority which winter tares, and bastard fallows, have over a naked fallow, see the Appendix, No. V.

357 Nothing else could be expected from so detestable a system, which cannot be too soon exploded.

358 Remarks by Edward Burroughs, Esq. This intelligent agriculturist adds, that he has known instances, in which lands thus exhausted, were in a great measure reclaimed, by growing green crops, and ploughing them in.

359 Much must certainly depend upon climate. In Jamaica it has been found, that exposing the soil to the heat of the sun, for any length of time, exhausts its fertility, and the practice is disused. Even subjecting lands to the fallow process, for some years, has destroyed their productive powers.

360 Mr Curwen's Report to the Workington Society, an. 1810, p. 88. In his evidence before the Salt Committee, (Report in June 1818, p. 57), this impartial observer states, "When one looks to the first farming in the kingdom, "which I think one may, without injustice to any, attribute to the Lothians, in "that system of farming, fallowing is a favourite practice."

361 See Mr William Pitt's Essay on the Extirpation of Weeds, in the Communications to the Board of Agriculture, vol. v. p. 240.—In Marshall's Gloucestershire, 77 are enumerated. See also Aiton's Survey of Ayrshire, p. 674; and of Bute.

362 See the valuable Section on Weeding, drawn up by George Rennie, Esq. of Phantassie, in the General Report of Scotland, vol. ii. p. 554.

363 Dr Skene Keith's Report of Aberdeenshire.

364 Derbyshire Report, vol. ii. p. 66. It is said, that the best forceps for that purpose, is the human hand, protected by a suitable glove. Thistles were formerly pulled in Scotland, not because they were weeds, but because they were useful; for owing to the scarcity of grass in summer, they were given to the farmers' horses in the evening. *Aberdeenshire Report*, p. 442.—It is said to be a practice in Germany, after they are collected, to beat them in sacks till their prickles are destroyed. Horses willl then devour them greedily. The roots of couch-grass, after being washed, have likewise been given as food for cattle in scarce seasons.

365 Derbyshire Report, vol. ii. p. 66. On broad-cast crops of corn, pincers are the only effectual means of relieving the crop from thistles or docks, should they get but *one* weeding.

366 In Mr Dombasle's valuable translation of the Code of Agriculture into French, he states, that the dock *(rumex acutus et obtusifolius)*, and the coltsfoot *(tussilago farfara)*, are both considered to be valuable plants in France, however much objected to by the British husbandmen. It is admitted, that these weeds ought to be extirpated in crops of grain, but it is contended, that they are useful in pasture fields. There certainly must be some mistake regarding the identity of these plants, to justify such a recommendation.

367 The public owes these valuable hints to Mr Rennie of Phantassie. The process is described at greater length in the General Report of Scotland, vol. ii. p. 554. It is much the custom with those who fallow land in Ireland, to permit the weeds to shed their seeds, under the idea, that when the land is afterwards ploughed, they will be destroyed. This is one of the reasons, why the lands in that country, under this system, become progressively more foul and less fertile.—*Remark by Edward Burroughs, Esq.*

368 This is likewise the case in the Fens of Cambridgeshire.

369 Hints on the Agricultural State of the Netherlands, p. 53.

370 Pitt's Essay on the Extirpation of Weeds, p. 255.

371 The white darnel, *(lolium temulentum)*, for instance, if ground into flour with wheat, and the bread eaten hot, will produce deleterious effects on the human body; and if malted with barley, the ale soon occasions drunkenness. *Withering*.—This, however, is a scarce plant with us. The true darnel of agriculture, is the *bromus secalinus* of Botany. It is annual, and grows almost as large and as strong as wheat.

372 Cheshire Report, p. 244. This is also the case in Derbyshire, vol. ii. p. 191.

373 North Wales Report, 305.

374 Communications to the Board of Agriculture, (by T. A. Knight, Esq.), vol. ii. p. 184. Mowing them twice in the same year, in pastures, would be equally effectual.

375 Kent Report, p. 164.

376 From the Communications of John Naismith, Esq. on Grass Lands. Others recommend cutting the stems before they run to seed, as likely, in process of time, to be effectual.

377 It is much disputed, whether the butter-flowers, *(ranunculus bulbosus, repens*, and *acris)*, should be considered as weeds or not. Horses are certainly not fond of these plants, but cows will eat the foliage of the *ranunculus repens*, greedily with other herbage.—*Pitt's Essay on the Extirpation of Weeds*, p. 362.

378 General Report of Scotland, vol. ii. p. 570.

379 Derbyshire Report, vol. ii. p. 101, note. This would be a most beneficial law, and were it extended to Ireland, it would be found doubly necessary. The practice of cutting weeds on the sides of roads, is so very uncommon among the farmers in that country, that the clean and industrious cultivator, has not only to eradicate the weeds natural to his own farm, but also those created through the neglect of his neighbour—*Remark by Edward Burroughs, Esq.*

380 Ibid. vol. ii. p. 177, 178.

381 By this means, Mr Westcar has completely eradicated thistles in his extensive pastures. *Buckinghamshire Report*, 239.—In Thorney Fen, the permanent pastures have been gradually cleared by the same process.

382 Essex Report, vol. i. p. 300.

383 Gloucestershire Report, p. 116. It is also practised in Worcestershire. *Report*, p. 205.—In 1817, thistles are said to have abounded so much among the barley crops, between Witney and Cheltenham, as frequently to exceed the corn in height.

384 Essex Report, vol. i. p. 300.

385 In Flanders, weeds are collected by hand labour in spring, and are boiled for milk cows, when green food is so difficult to be procured. The farmers thus get their lands weeded by the neighbouring cottagers, *for nothing*, solely for the purpose of procuring these weeds for their cattle, and the farmer is thus gratuitously freed from a great nuisance.

386 Pitt's Essay on the Extirpation of Weeds, p. 256. Marshall's Yorkshire vol. i. p. 368.

387 Derbyshire Report, vol. ii. p. 177.

388 Maison Rustique, tom. i. p. 640.

389 See Withering, quoted by Pitt, 451. It is stated in the South Wales Report, vol. ii. p. 195, that of all weeds, corn marigolds are the most difficult to extirpate. These weeds, if abundant, are apt to stick together, and to turn into a kind of mucilage, which prevents the crop from drying, and is injurious both to the straw and the corn.

390 See Skene's edit. of Regiam Majestatem; Leges Alex. II. cap. 18. Also Lord Hailes's Annals, Appendix, No. 3. The statute is very short, and ably expressed. It denounces that man to be a *traitor*, " Who poisons the " king's lands with weeds, and introduces into them " *A host of enemies*."—Bondsmen who had this plant in their corn, were fined a sheep for each stalk.

391 Statist. Account of Scotland, vol. ii. p. 4.

392 Berkshire Report, p. 365.

393 North Riding Report, p. 240.

394 This great source of mischief, is not so much thought of as it merits. No plant can thrive without moisture, and hence those weeds, which absorb much moisture, are particularly pernicious.

395 When weeds cannot be extirpated by the horse or hand hoe, I have always found it necessary, to cut them *twice* when in corn crops—the first about

the middle of May, and the second early in July. Some farmers, through economy, (a most mistaken one), cut only once, and this is not performed till the weeds have grown so rank, that part of the crop is destroyed, and more of it seriously injured. By the *two* weedings, especially on thistles, the crop is kept clear of weeds, and the land freed from the seed they would consequently produce.—*Remarks by Edward Burroughs, Esq.*

396 Forfarshire Report, p. 416. The diminution and deterioration of crops, and in some cases the actual loss, by weeds, is equal to the rent.—*Cornwall Report*, p. 136.

397 Mr Calvert in Nottinghamshire, had a crop of wheat that seemed to be smothered with weeds. He hand-weeded it in April, and the produce was nearly four quarters per acre, weighing 65 pounds per Winchester measure.—*Notts Report*, p. 117.

398 See an Account of Experiments in weeding Broad-cast Crops, by Mr John Wright, of Pickworth: Communications to the Board of Agriculture, vol. vi. p. 387. The weed that grew in the wheat land, is a rampant branching plant, with a blue flower, and is provincially called *Midsummer*, from its growing at that season of the year.

399 Pitt's Essay on the Extirpation of Weeds, p. 257.

400 Cornwall Report, p. 136. Considering the *vivacious* principle with which weeds are endowed, it is not amiss to recollect, that if it were *not so*, there would be little difference between the good husbandman and the sloven. Thus incessant care is excited, and the reward is found, in the esteem that is excited, and in the profit that is produced.

401 See Dr Singer's Treatise on Irrigation, in the General Report of Scotland, vol. ii. p. 574.—Derbyshire Report, vol. ii. p. 464.

402 In preparing irrigated meadows, covered drains can never be safely resorted to, because the water would almost certainly get down into them, and destroy them; and in most instances, the ridges may be made sufficiently high and steep, to effect a sufficient drainage.—*Derbyshire Report*, vol. iii. p. 465.

403 Statistical Account of Scotland, vol. iv. p. 94.

404 Ibid. vol. xv. p. 82.

405 Ibid. vol xvi. p. 471.

406 Aberdeenshire Report, p. 444.

407 Statistical Account of Scotland, vol. xv. p. 88.

408 Somerset Report, p. 266. This tract is on the demesne of Mr Luttrel, of Dunster Castle.

409 Observations on the Utility of Water-meadows, by William Smith, Engineer and Mineralogist. Printed an. 1806, p. 39.—Marshall on Landed Property, p. 260, calls it a *probable improvement.*—See also Derbyshire Report, vol. ii. p. 484.—The late Duke of Bedford had it in view, to adopt this plan of temporary irrigation, for arable land. It has been found of great use, at Woburn Abbey, to irrigate strawberries.

410 Statistical Account of Scotland, vol. xii. p. 286. Parish of Forgue.

411 Derbyshire Report, vol. ii. p. 459, and 466.

412 Wiltshire Ropert, p. 119.

413 Communications by Mr Boulton, a flooder, or floater, from Gloucestershire. General Report of Scotland, vol. ii. p. 596.

414 The owners of canals ought to be the greatest promoters of irrigation. The waste water of the canals in England might irrigate many thousand acres.

415 Smith's Observations, p. 68 and 74.

416 Gloucestershire Report, p. 165.

417 Smith's Observations on Irrigation, p. 28.

418 Remark by the Rev. Robert Hoblyn.

419 These waters generally hold in solution, a portion of oxide of iron, or rust, supposed to be a preventive of the rot, as sheep in the Cambridgeshire fens, where that substance abounds, never take that disease.

420 Dr Stringer's Treatise, p. 579.

421 Derbyshire Report, vol. ii. p. 463.

422 Smith's Observations, p. 26.

423 Water is of great benefit to peat-bogs, or mossy grounds, by washing away improper ingredients, as the sulphate of alumina, by which that description of soil is rendered unfertile. In this way peat-bogs may be enabled to produce succulent and nutritive grasses, and to rival the best natural meadows.

424 Smith's Observations on Irrigation, p. 44; Derbyshire Report, vol. ii. p. 462.

425 Observations by Mr Boulton, the Gloucestershire flooder.—General Report, vol. ii. p. 599.

426 Observations by Mr Boulton.—General Report, vol. ii. p. 598.

427 Smith's Observations on Irrigation, p. 56.—Various accounts were transmitted to the Board of Agriculture, of the expense of making water-meadows in different districts. The Rev. Mr Clough, near Denbigh, in North Wales, expended L.868 in forming about 30 acres into a water-meadow, which is nearly at the rate of L.30 per acre. *Comm.* vol. i. p. 263.—Mr Eyres, of Lynford Hall, in Norfolk, improved in the same manner 23 acres, at the expense of about sixteen guineas per acre, besides some extra charges. *Ditto,* vol. vi. p. 329.—Mr Wilkinson, of Potterton Lodge, near Wetherby, in Yorkshire, converted 13 acres into water-meadow for about L.12, 12*s.* per acre. *Ditto,* vol. vi. p. 48.—And two spirited farmers of Norfolk, (Mr Beck of West Lexham, and Mr Purdy of Castle-Acre), have tried irrigation with great success, at an expense of L.30 per acre. *Ditto,* vol. vii. p. 108 and 112.

428 Communications to the Board of Agriculture, vol. vi. p. 45.

429 Ibid, vol. vi. p. 329.

430 Ibid. p. 269.

431 General Report of Scotland, vol. ii. p. 601.

432 Hampshire Report, p. 277.

433 It is generally supposed, that sheep would be *rotted,* by pasturing on watered-meadows at any time, except *in the spring;* but in Derbyshire, there are several well-authenticated instances to the contrary.—*Report,* vol. ii. p. 472 and 475. Much probably depends upon the slope, but more on the soil or water being calcareous. It is said that in Ireland, sheep and lambs are rotted on water-meadows *even in spring,* but that is not the case in England.

434 Half an acre of water-meadow will support 1000 sheep per day, in spring.—*Smith's Observations,* p. 111.—*Wiltshire Report,* p. 127.

435 Smith's Observations, p. 111.

436 Wiltshire Report, p. 128.

437 Communications to the Board of Agriculture, vol. vi. p. 47.

438 Buckinghamshire Report, p. 283; Transactions of the Highland Society, vol. iii. p. 201, and 283.

439 Dr Singer has given some very judicious directions for that purpose.—*General Report of Scotland,* vol. ii. p. 610, &c.

440 Berkshire Report, p. 370, note.

441 Wiltshire Report, p. 122.

442 Rutland Report, p. 114.

443 The large water-dock is the weed that principally infests water-meadows. It ought to be carefully eradicated.—*Smith's Observations,* p. 40.

444 In Davis's Wiltshire, it is calculated, that 2000 acres of water-meadows will, on a moderate estimate, produce in four or five years, 10,000 tons of manure, and will keep in permanent fertility 400 acres per annum of arable land.

445 Gloucestershire Report, p. 280.—Watering of land, is also of use, by destroying vermin in the soil. Bakewell practised this with success in lands under tillage. Red worms were thus destroyed, as well as snails, and grey slugs,

though they in general like moisture, and injure crops most in damp weather, yet do not agree with wetness.

446 Smith's Observations on Water-Meadows, &c. p. 93. The celebrated wheel invented by Mickle, and employed for raising water to float off the moss at Blair-Drummond, in Stirlingshire, might supply the water. Mr Boys mentions a wind-pump near Deal, that costs only thirty guineas, and would raise 1600 butts in twenty-four hours.

447 Middlesex Report, p. 322.

448 Smith's Observations, p. 87.

449 Several works are published, which give practical directions for the formation and management of water-meadows: as those of Wright and Boswell, —Smith's Treatise, above quoted,—and Mr Young's Calendar. In the Appendix to the General Report of Scotland, vol. ii. p. 130, there are several useful plans and suggestions, by Mr John Boulton, a native of Gloucestershire, who had been for seven years an irrigator there, and has since practised for above twelve years in Aberdeenshire.

450 Statistical Account of Scotland, vol. iv. p. 260.

451 The plan resembled in principle the modern system of warping.

452 Marshall's Midland Counties, Minute 27.—The system of *floating upwards* ought, however, not to be given up, as it may answer in many cases, where irrigation cannot be practised, but at an enormous expense.

453 After fens are flooded by the breaking of banks, the water generally lies on the ground during a whole year: much mischief is done, but the land produces afterwards great and clean crops.

454 Colonel Fullarton's Report of Ayrshire, p. 48; and General Report of Scotland, vol. ii. p. 361. The crops should be sown on lazy-beds.

455 The observations on the flooding waste lands, are principally taken from Dr Rennie's Treatise upon that subject, printed in the General Report of Scotland.—Appendix, vol. ii. p. 17.

456 In the end of summer, and beginning of autumn, if there is *a severe frost* for a few hours, its effects are peculiarly destructive near flooded lands.

457 An account of this curious practice was given me by the Baron A. de Meyondorff, a Livonian nobleman, in 1329, whose post-town is Riga.

458 When the political divisions of a country are made the basis of inquiry, no part of it is overlooked or neglected; and there is reason to expect, that every local useful practice may be brought to light, and ample information obtained, regarding the real state of a country, and the means of its improvement.

459 Lincolnshire Report, p. 326.

460 An account of the Italian practice will be found in the Appendix, No. XII. p. 44.

461 Mr Day of Doncaster, (West Riding Report, p. 171), states, that warping was first tried "about 50 years ago," and his information was given in 1793. Mr Marshall was informed at Booth Ferry, near Armin, that one Barker, a small farmer at Rawcliff, was the first warper of land; and that Jeunings of Armin, was a stewart or professional person, *who extended the practice.* Tradition says, that Barker, like other men of aspiring genius, hurt himself at the outset, (as is too often the case), by the prosecution of his scheme, which he was, in consequence, on the point of giving up; but laying his case before a friend, he advanced him fifty pounds, which enabled him to complete his grand design, by which he afterwards made a little money, so as to be able to forward his children's progress in life. One of his sons is now settled in business at Hull. Mr Marshall very properly adds, that those who have made, or are making fortunes by this discovery, ought to ascertain who made it, and should lose no time, in raising a monument to his memory. *Eastern Department*, p. 107, note.— Mr Wells, of Booth Ferry, near Howden, mentions it as a tradition, that the utility of this process was *an accidental discovery.* A stubble field was inundated with water from the river, and covered with mud. The benefit which the field

derived from the enriching substances thus brought to it, was the cause of Mr Barker's proceeding.

462 Mr George Rennie of Phantassie, Mr Robert Brown of Markle, and Mr John Shirreff, then farmer at Captainhead in East-Lothian.

463 Lincolnshire Report, p. 316.

464 Marshall's Eastern Department, p. 103.

465 West Riding Report, p. 164.—Lincolnshire Report, p. 315.

466 Ibid. p. 170.—Marshall's Eastern Department, p. 105.

467 Their depredations might be prevented, by salt strewed on the surface after the crop was sown.

468 It is not improbable, that the practice of warping may be greatly extended. Perhaps warp might be raised by machinery from the bottom of the estuary, to be brought up by the tide; and if the water impregnated with it were raised to a higher level, it might be conveyed to a greater distance, and the sediment, kept in a flowing state, would not be deposited, till it was suffered to rest. It might be worth while to convey to the warp itself, when deposited, to a certain distance, on iron railways, or canals, which are so easily made in a flat country; and which was actually done by the Duke of Bridgewater, to a considerable extent, on his celebrated canal. It is an excellent dressing for garden-ground, and is said to be an antidote to the rust or mildew.—*Dumfriesshire Report*, Appendix, 531.

469 Marshall's Eastern Department, p. 115.

470 In Chapter V. the means of promoting such undertakings, by public encouragement, shall be explained. It is a most unfortunate circumstance, that there should be such a prejudice against the granting of public encouragement to promote agricultural improvements. Were such improvements properly attended to by the Government of the country, no individual in it need to remain unemployed.

471 Edinburgh Review for March 1817, p. 44, 45. Torricelli, the celebrated inventor of the barometer, was born anno 1608, and died anno 1647. There is a good account of this Italian process, in the travels of W. A. Cadell, Esq. in the years 1817, &c. See also the Scottish Farmer's Magazine, published in May 1820, p. 160. It appears, that by the process *Colmata*, the ground is rendered unproductive for seven or eight years; but by the English system of *warping*, it will produce clover immediately after the process is completed.

472 Johnston's Chapter on Embankments, in the General Report of Scotland, vol. ii. p. 615.

473 Mr Smith, the mineral surveyor, has effected this on the coast of Suffolk, with much ability. Mr Maddock's great embankment on the coast of Wales seems to be of the same description.—*Communications to the Board of Agriculture*, vol. vi. p. 150.

474 Beatson's Essay on Embankments; Communications to the Board of Agriculture, vol. ii. p. 244.

475 Statistical Account of Scotland, vol. xviii. p. 220.—Stirlingshire Report, p. 280.

476 In the Gloucestershire Report, p. 264, there is an account of a valuable embankment and drainage, by which 1300 acres of land are improved, where the surface of the river is above that of the adjoining meadows.

477 Berkshire Report, p. 236.

478 This actually happened at Wester Fintray, in Aberdeenshire, where several hundred quarters of corn were carried off, by a sudden flood, in 1768. The farm has since been embanked.

479 Johnston's Chapter on Embankments, General Report of Scotland, vol. ii. p. 626.

480 The plans of executing Embankments are fully explained in Beatson's Essay on that subject, Communications to the Board of Agriculture, vol. ii. p. 231; and in Johnston's Chapter on Embankments, in the General Report of Scotland, vol. ii. p. 615.

CHAP. IV.

1 Deep ploughing permits the surface-water to pass beneath the roots of the crop in winter, and admits the action of the air and influence of the season in summer; hence a powerful evaporation is carried on, which supplies the plants with moisture during the driest weather. After every ploughing, the earth exhales as much as after the most copious shower of rain.—*Curwen's Report*, p. 54.

2 Coventry's Discourses, p. 73.

3 Marshall's Gloucestershire, vol. i. p. 12. It is contended by Marshall, and others, that if the operations of tillage were better performed, it would add one-third, or at least one-fifth to the produce of the kingdom.

4 General Report of Scotland, vol. ii. p. 314.

5 This is called *Fox-earth* in Derbyshire.—*Report*, vol. i. p. 305; and *Fox-bench* in Cheshire.—*Ditto*. In Norfolk also, it is considered to be hazardous to plough up the black retentive subsoil, so frequent in that district; but any soil, with a subsoil capable of being pulverized, may be gradually, and successfully deepened.

6 When soils are deepened, lime should always be applied, to correct any noxious ingredients in them;—and putrescent matters, to give the soil an adequate degree of fertility. It is a mistake, to suppose, that deepening the soil, *renders a much greater quantity of manure necessary*. The most intelligent farmers do not think that more than from ten to sixteen per cent. additional is required.

7 This maxim the farmers of Flanders acted upon, gradually deepening their soil, as their manure was augmented. Mr Young observes, that in poor *hungry* soils, some proportion ought to be observed, between the depth of a ploughing, and the quantity of manure annually spread.—*Calendar*, p. 510.

8 I have made many experiments in order to ascertain the advantages to be derived from deep ploughing, all of which have proved the benefit of the practice. Even in many instances, in which the subsoil brought up, was, to all appearance, very unfertile, the surface-soil was much benefited. A very simple and curious circumstance led me into a knowledge of this fact. A tenant on the land, had made a pit of potatoes in an angle of a field, then a wheaten stubble: the pit was dug eighteen inches deep, and about twenty yards long, after being filled with the roots and well covered by the soil from both sides. On the potatoes being consumed, the wheaten stubble was sown with oats, including the angle as already described. This crop proved indifferent, except on the angle where the subsoil was thrown up, which was most luxuriant, and which retained its fertility for two years afterwards. In another case, when drains had been made to carry off the surface-water from a field sown with rape, all the plants which grew near to the subsoil thrown up in this operation, grew more luxuriant than those in any other part of the field. From the fertile effects which this subsoil produced, and from its adhesive nature, I conceived it to be a species of marl; but on trying its properties, found it did not possess any calcareous matter.—*Remark by Edward Burroughs, Esq.*

9 Deep soils are generally the driest in wet seasons, but in very wet seasons, they are thought to be the wettest, because they are the longest in drying.

10 In shallow soils, there are very often great inequalities in the crop, and that in places of a field quite contiguous to each other.

11 Mr Parker, of Munden, prefers nine inches for the depth of ploughing, and he has practised that system for many years, on good loamy land in Hun-

tingdonshire, as well as in the clay and flints of Hertfordshire. He never lost a crop by it, but has met with unvaried success; and he is clearly of opinion, that the propriety of deep ploughing, ought not to be made a question, but received as an admitted truth.—*Herts Report*, p. 60. The farming gardeners near London, act upon the same system, with great success. They plough to the depth of from ten to twelve inches for cabbages and other crops, with implements made on purpose, and with from six to eight powerful horses.—*Communication from John Middleton, Esq.* Mr Marshall has known a succession of shallow ploughing farmers beggared on a stiff-land farm; and their successors, by deeper tillage, make a farmer's fortune upon it.—*Review of the Eastern Department*, p. 339. Great caution however must be used, where the substratum is of an unfertile quality.

12 Communications from Mr Gascoigne.

13 This is most effectually done by the process called *ribbing*; but the leaving the lower part of the triangle untouched, where the field is only partially ploughed, is much objected to.

14 This is the general, if not the universal opinion of the Scotch farmers. The angle of 45 degrees is strongly recommended in Bailey's Essay on the Construction of the plough, in his Durham Report, p. 102, and in Brown's Treatise on Rural Affairs, vol. i. p. 219. By the alterations made by Wilkie in Small's plough, the furrow-slice sets up a bolder shoulder, and thus, when operated upon by the harrows, raises more mould, and covers the seed better than formerly.

15 Communication from John Middleton, Esq.

16 In Middlesex, these corn stubbles, if tolerably clean, are frequently sown with tares.—*Communication from John Middleton, Esq.*

17 Warwickshire Report, p. 67. When ploughing two yokings, the horses must be less fatigued, as post-horses, when driven 30 miles in a day, are better able to perform their work in two stages, than in one.

18 Husbandry of Scotland, vol. i. p. 225; Leicestershire Report, p. 87.

19 Kent's Norfolk, p. 37.—Marshall says, that the common day's work, except in wheat seed-time, is two acres; a fact, he adds, which nothing but actual observation could have taught him to believe.—*Norfolk*, vol. i. p. 139.

20 Marshall's Norfolk, vol. i. p. 139.

21 A furrow-slice of this great width, will always be completely turned upside down.

22 Communication from Mr Blaikie at Holkham, in Norfolk. They frequently change their horses in the middle of the day, and then plough from an acre and a half, to two acres, with the same plough and ploughman. In the heavy part of Norfolk, the quantity is only about an acre per day.

23 In one instance specified in the Middlesex Report, p. 130, the expense is estimated at 27s. per acre, for one bad ploughing; but that is a singular circumstance.

24 Marshall's Norfolk, vol. i. p. 143.

25 Middlesex Report, p. 104.

26 It is only within these few years, that the farmers in many parts of Ireland have been convinced, that strong soils can be effectually worked, by two horses, and a well-constructed plough; but latterly, seldom more than this number is used for this purpose, except when summer fallowing strong soils.

27 Observation made by Mr Middleton.

28 Horse-hoeing Husbandry, 2d edit. p. 43.

29 Mr Middleton observes, that where ridges are broad and high, this beneficial operation is prevented.

30 Communications to the Board of Agriculture, vol. iv. p. 147.

31 Wiltshire Report, p. 52.

32 In Ireland, the various ploughing matches, encouraged by the Farming Society, have been a chief means of forwarding the improved agriculture of the country.—*Remark by the Rev. Thomas Radcliff.*

33 This benefit might be obtained, were proprietors to resolve, not to let their land to any one, who did not become bound to use improved swing-ploughs, and, unless in particular cases, worked by two horses. It is said, that *in the infancy of good ploughing*, it is a great object, to have, by means of wheels, a number of ploughs, upon the same farm, correctly worked by unskilful boys, under the guidance of one good workman to regulate the irons.—*Remark by the Rev. Thomas Radcliff.* But they will soon learn to plough, without the appendage of wheels, under a skilful and *willing* overseer.

34 Kent Report, p. 65.

35 Kames's Gentleman Farmer, p. 73.—Where it is wished to have no interfurrows, the best mode is, to plough the land in broad level ridges, and then to fill the interfurrow, by going once round it with the plough. The ridges direct the sower, &c. and yet the land, when harrowed, is left quite flat.

36 Lord Kames is of opinion, that though clayey soils should in all cases be ridged, yet loamy soils should be tilled flat in a dry country, but ridged in a wet one, high or low, according to the degree of moisture and tendency to clay. *Gentleman Farmer*, p. 73. There is a peculiar mode of forming arable land in some parts of Flanders, in particular, the " *Pays de Waes,*" which it may be proper to describe. The fields are small, usually about seven or eight English acres, and the whole ground is raised in the middle, gradually sloping to the ditches, into which the water naturally descends, the soil being of a sandy quality. These fields are called " *Terres Bombes.*" They were formed by the spade, the digging commencing in the centre, and the earth being thrown upwards. It is singular to see a whole district full of these little hills or eminences. The fields are in general surrounded with trees, whose roots expand themselves in a lower stratum than the roots of the grain.

37 These were the sentiments of that eminent Norfolk farmer, the late Mr Money Hill.

38 In Suffolk and Essex, where hollow-draining is universal, the ridges are two *bouts*, or four furrows of the plough, when land is fallowed. By the hollow-drains, every objection on the score of wetness, is removed, but it is a very expensive operation.—*Communication from the late Arthur Young, Esq.*

39 Marshall's Gloucestershire, vol. i. p. 79.

40 It is said, that a good sower, will scatter the seed sufficiently correct, in ridges of any breadth ; but such sowers are not always to be met with.

41 Donaldson's Modern Agriculture, vol. ii. p. 267.

42 The high ridges of the Vales of Evesham and Gloucester, have long been proverbial. They are often from 15 to 20, and even 25 yards wide, and from four feet, to four feet three inches, and sometimes more in height ; but eight yards wide, and from two to two and a half feet high, is the favourite size. Even a ridge of these dimensions, however, is more steep-sided than is necessary. These masses of earth, were probably accumulated, in order to render the land dry ; but they cannot be too severely reprobated, since the art of draining has been so much improved. See Marshall's Gloucestershire, vol. i. p. 75 ; Rudge's Gloucestershire, p. 105. When ridges are high in pasture lands, sheep are apt to fall upon their backs between the ridges. This rarely happens, however, but in moonlight nights, for in dark ones they never stir.

43 Gentleman Farmer, p. 74. From about three to four inches in height, per yard in width, is considered a proper height. In spring crops, oats are better on flat land than barley, the ordinary varieties of oats requiring more moisture than those of barley.

44 Some farmers, where the field is very steep, plough only down hill, the plough being drawn up empty ; but this is hardly ever necessary, if the fourth plan is adopted. Where the declivity *is very considerable*, it is questionable whether the land ought to be ploughed at all, the soil is so apt to be washed down the hill.—(See Statistical Account of Scotland, vol. ii. p. 142, note).

45 Gentleman Farmer, p. 97.

46 Young's Calendar, p. 510.

47 "The preferable method for sowing oats, and especially in a clay soil, is to turn the field over after harvest, and to lay it open to the influences of frost and air; which lessens the tenacity of clay, and reduces it to a fine mould. The surface soil, by this means, is finely mellowed for the reception of the seed; *which it would be a pity to bury, by a second ploughing, before sowing.* We are taught by experience, that this soil, ploughed before winter, is sooner dry, than when the ploughing is delayed till spring; and as early sowing is a great advantage, any objection, on account of the superficial crusting, is easily removed by a strong harrow, which would produce abundance of mould for covering the seed.—*Kames's Gentleman Farmer*, p. 95 and 96.

48 For potatoes or turnips, spring culture is considered necessary in Ireland. *Remark by Edward Burroughs, Esq.* But the practice of spring sowing, without ploughing, has been adopted on strong land in some parts of Ireland, with great advantage; and the oat crop thus sown upon a retentive clay, will be a fortnight earlier, than that sown upon a spring ploughing.—*Remark by the Rev. Thomas Radcliff.*

49 It is said that Finlayson's scarifier, and Wilkie's new invented scuffling harrow, are improvements upon the grubber.

50 It is likewise aërated, for in fine free soils, the scarifier enables the air to pass two or three inches below the surface of the soil.

51 An experiment of the effects of scarifying, compared with spring ploughing, was tried in spring 1811, by Mr Robert Roberts, of Gorewell, about seven miles from Bridport in Dorsetshire. He had a field of about forty acres of flinty loam, under a crop of broad-cast turnips, eaten off by sheep. Not being able to plough the whole field in time for a crop, he got a scarifier, and used it at the rate of about 12 acres a-day, followed by the sower, and the harrow; four acres were ploughed, the rest were scarified. The crop was oats, and the scarified part was greatly superior to the ploughed, in the proportion of nearly one-third.

52 Communications by the late Arthur Young, Esq. in the Husbandry of Scotland, vol. ii. Appendix, p. 66.—Mr Middleton remarks, that this excellent practice is inconsistent with broad ridges.

53 Essex Report, vol. i. p. 420.

54 In the Suffolk Report, Appendix, p. 350, there is an account of about twenty intelligent practical farmers, who have persevered in the practice for several years with success. See also Mr Moseley's Letter to Sir John Sinclair, dated in April 1813, confirming that information. In Derbyshire, scuffling strong land is preferred to harrowing, the former loosening the soil, and exposing it to the sun and air, whereas harrowing tends to consolidate it.—*Report*, vol. ii. p. 48.

55 Comparative trials have been made of the effects of harrowing for a barley crop; and the difference in favour of harrowing, was above L. 2 per acre, while the expense was only three shillings. In regard to crops of wheat, however, sown before winter, an idea has become prevalent, that too much harrowing is detrimental. When the surface is rendered too fine and smooth, the plants are apt to be thrown out.

56 General Report of Scotland, vol. i. p. 217 and 360.

57 Brown's Treatise on Rural Affairs, vol. i. p. 276.—Some farmers prefer finishing heavy land by cross-harrowing, to facilitate the descent of surface-water from the crowns of the ridges, to the interfurrow.—*General Report of Scotland*, vol. i. p. 361.

58 Young's Norfolk, p. 191. When done only once, they go over from 12 to 15 acres.

59 General Report, p. 362. It is proper to observe, that, to a certain extent, the greater number of harrows, attached under the *same yokes*, the more work, in proportion, will be done; and of course the cheaper it will be executed.

A driver with one horse, and one harrow, makes an extremely thriftless operation; two horses, and two harrows are better; but three is the best mode of any; for more than three it is very difficult to manage. The reason why two harrows are better in proportion than one, and three than two, is, that a small piece of land, at the extreme diagonal corners of the space covered by the harrows, is insufficiently done, and must be overlapped the next time the harrows go round. This piece is to the same extent, when one harrow is used single, as when two or three are yolked together. Thus, when one harrow is yoked by itself, it will not sufficiently harrow more than two feet and a half. But two harrows together, will harrow six feet, and three will harrow ten feet and a half equally well. Each harrow, after the first, adds four feet to the space, properly harrowed. Hence, three harrows in a set, are better than four harrows separately, besides requiring only one driver, instead of four.—*Communication from Mr George Robertson, author of the Mid-Lothian Report.*

60 Bedfordshire Report, p. 278. General Report of Scotland, volume of Engravings, Plate 5, Figure 10.

61 Essay on Rolling, by Mr Christopher Morley. Comm. to the Board of Agriculture, vol. ii. p. 148.

62 North Wales Report, p. 118.—Mr Blaikie at Holkham, recommends a double spike roller, as preferable to a single one, for the purpose of pulverizing strong soils. It is formed, by two rollers hung in the same frame, so close that the spikes of one work through those of the other. It is a ponderous implement, not liable to be clogged; and literally grinds the soil. It is necessary to wind this roller up, when it turns at the end, or for safe conveyance from one field to another. This is done by a hand-rack fixed on the frame; the fulcrum, a pair of low strong wheels, attaches to the side of the frame.

63 Gentleman Farmer, p. 26. For this purpose a roller, with sharp pointed darts, made either of forged iron, or cast metal, has lately been invented, which effectually reduces these clods. An engraving of one is in the General Report of Scotland, volume of Engravings, Plate 6, No. viii.

64 Derbyshire Report, vol. ii. p. 46.

65 It is improper to roll land before winter for wheat. It is better that the surface should be lumpy and uneven. In 99 cases out of 100, when the surface is too smooth before winter, the crop is hurt by the frost. Even when wheat is sown in February, the roller must be used with caution. If the land lies rough in winter, in all probability the water passes through it more freely, by which the plant is more effectually preserved dry; and it is well known, that strong soils are the more liable to become cohesive, after being well pulverized, particularly if the operation is not performed when they are in a very dry state.—*Remark by Edward Burroughs, Esq.*

66 A small stone, or wooden roller, is commonly used; but it is now ascertained by experience, that, on light soils, a heavy roller is much more effectual for the destruction of the fly, or rather beetle, which is thus either crushed, or so shut up in the ground, that it cannot extricate itself.—*General Report of Scotland*, vol. iii. p. 406. At the same time, caution is necessary in using the roller on turnip-seed, when the land is moist, and the soil is at all of an adhesive quality; as the seed is apt to adhere to the earth collected in the course of the operation. When the land is not perfectly dry, a few bushes tied together like a large broom, and drawn by a boy down the drills, is the most advisable mode of covering the seed, and it may be done at the rate of two acres per day.—*Remark by Edward Burroughs, Esq.*

67 Mr Vagg of Chilcompton was rewarded with several hundred pounds, for publishing an account of the means of destroying slugs by midnight-rolling. For the fly or beetle, day-rolling is more likely to be useful.

68 Brown on Rural Affairs, vol. i. p. 279.

69 After the miserable crops of 1782, some experiments were tried in Scotland, to fix, if possible, on some decided marks by which good seed might be

distinguished from such as was injured by frost. It was soon found by experience, that no stress at all was to be laid on the appearance of the grain in its natural state. In regard to oats, it was found; 1. That the clearest, and best looking oats, when sown, often produced the worst crop; 2. That the grain which yielded, when milled, the greatest quantity of meal, was far from having the best vegetative powers; and, 3. That because the grain sprung readily when put into a pot of earth, it could not, therefore, he depended upon as good seed; for it often sprung readily through the ground, without having strength enough to bring the plant to maturity. On the whole, it was found, that the best mark by which sound seed oats can be distinguished from such as are injured by the frost, was, to examine the grain, when stripped of the outer husk; and to consider that as the best seed, which, in that state, is plump, and clear, and free from shrivelling, and darkness of colour, more especially at the extremities. *Statistical Account of Scotland*, vol. iv. p. 550.—It has been found that seed, when it has been much exposed to frost, will often never vegetate; that above double the quantity is necessary; that it will not yield one-third of the produce of good seed, and that the quality is much inferior.

70 Coventry's Discourses, p. 82.

71 General Report of Scotland, vol. i. p. 373.

72 Gentleman Farmer, p. 333.—Marshall's Southern Counties, vol. i. p. 120.—Farmers on the borders of Lincolnshire, make a considerable advantage, by purchasing their seed wheat from the Fens. They find the change useful, and at the same time save in the price. The annual change of the different seeds, is found to be of great advantage, as the same seed, sown successively for years, in the same soil, becomes gradually small and unproductive.—*Statistical Account of Scotland*, vol. viii. p. 337. In Flanders, they never use the grain or seeds grown on the lands to be sown, nor regard the additional expense attendant on the purchase of seed that is heavier and more healthy. Their flax-seed they bring from Riga or Memel, and their potatoes from Brabant.—*Vanderstraeten's Improved Husbandry*, p. 51. The Farming Society of Ireland, by its premiums, introduced the habit of sowing seed imported from England. By this means, the quality of the Irish grain is greatly improved, and the samples of corn now produced for sale at the Irish, would not disgrace any English market.—*Remark by the Rev. Thomas Radcliff.* English grain, sown in Ireland, generally comes to maturity ten days, or even a fortnight, earlier than the native seed under similar circumstances.—*Remark by Edward Burroughs, Esq.* Potatoes produced in burnt land, yield the best seed of Irish growth.—*Ditto.*

73 Gentleman Farmer, p. 330.—To ascertain these points, an intelligent farmer in the Lothians, sowed English seed wheat, from London, with some of his own, and it was always earlier by several days. He has likewise tried sowing seed wheat, equal in quality to his own, from a situation where the climate produces crops ten days later than the farm he occupies, and it was nearly a week later than his own seed sown at the same time.—*Husbandry of Scotland*, vol. i. p. 355.

74 Gentleman Farmer, p. 327 to 336.

75 Sir Humphry Davy's Elements, edit. 1813, p. 225; and the Philosophical Transactions for the year 1799.

76 Marshall's Yorkshire, vol. ii. p. 20.

77 Marshall's Norfolk, vol. i. p. 224.

78 General Report of Scotland, vol. i. p. 456.

79 Remark by John Middleton, Esq.

80 Dickson's Practical Agriculture, vol. viii. p. 451.

81 Impressed with this idea, Mr Coke of Norfolk sows, under the drill system, four bushels of wheat, three of barley, and six of oats, per statute acre.

82 Remark by Edward Burroughs, Esq.

83 General Report of Scotland, vol. i. p. 456. Brown on Rural Affairs, vol. ii. p. 16.

84 Marshall's Gloucestershire, vol. i. p. 118.

85 General Report of Scotland, vol. i. p. 489.—Brown on Rural Affairs, vol. ii. p. 45.—The ideas and experience of the farmers in Ireland, are totally different. In that country, barley, in well cultivated and good soils, tillers as much as wheat, and the head produced from these collateral shoots, are as productive, as from the main stem, or parent plant. Some of the best farmers in Ireland, sow their barley *thin*, on well prepared land, and find it injudicious to sow it on lands on which the plant would not tiller.—*Remark by Edward Burroughs, Esq.*

86 Marshall's West of England, vol. i. p. 194. Ditto, Yorkshire, vol. ii. p. 20.

87 General Report of Scotland, vol. i. p. 501. Brown on Rural Affairs, vol. i. p. 49.

88 General Report of Scotland, vol. ii. p. 519. Brown on Rural Affairs, vol. ii. p. 61.

89 Marshall's Norfolk, vol. i. p. 251.

90 General Report of Scotland, vol. i. p. 530.

91 Coventry's Discourses, p. 84.

92 Ditto, p. 80.

93 For three seasons, the plan of steeping turnip seed in train-oil, prevented the attack of the fly at Lord Orford's, in Norfolk. See Appendix, p. 70. The evening before the seed was to be used, as much as would be required the next day, was first steeped in train-oil, and then kept in salt pickle during the night. Seven gallons of oil, is sufficient to prepare seed for two hundred acres of turnips. There was a partial failure of this process, to the amount of thirty acres, which was attributed to an excessive rain having fallen, by which the noxious quality of the oil was destroyed.—*Annals of Agriculture*, vol. xiv. p. 168.

94 In the spring of 1783, a farmer in Cornwall, (Mr James Chapple, in Bodmin,) soaked his seed barley in dunghill-water, in which it lay for 24 hours. All the light corn which floated on the surface, was skimmed off. On taking it out of the water, a sufficient quantity of sifted wood-ashes, to make it spread regularly, was mixed with the seed; and three fields were sown with it. The produce was 60 bushels per acre, of good clean barley; while several fields belonging to the farmer himself, and to his neighbours, where no preparation had been used, were very poor, not producing more than 20 bushels per acre. *Papers of the Bath Society*, vol. iii. p. 303.—Dunghill-water, however, must be used with great caution, as a steep. If diluted, it can do no great harm, but if kept for some time, in a concentrated state, it becomes highly putrescent, and may prove detrimental, and indeed may destroy the vegetative powers of the plant.

95 It is an old proverb, " That an early sowing sometimes deceives, but a late sowing never, for *the crop from it is always bad.*"—*Dickson's Husbandry of the Ancients*, vol. ii. p. 18.

96 Its produce on the *Polders*, or carse lands, is 10 quarters per English acre, or 15 bolls and a half per Scotch acre. Carse land is peculiarly calculated for this species of grain.—*Radcliff's Flanders*, p. 15. In Ireland, it is known under the name of *bere* or *bigg*, and is frequently sown in autumn, with much success. It is considered a valuable crop on lands that have been pared and burnt, and on lands of a friable, and a fertile quality.—*Remark by Edward Burroughs, Esq.*

97 Winter barley has been sown by Mr Ellman of Glynde, in Sussex, principally as spring feed for his sheep, but on the whole, he prefers rye, being a fortnight earlier.

98 Communication from Thomas Radcliff, Esq. of Globe-Hill, near Enniscorthy, in Ireland.

99 Several farmers, who are friends to the drill, admit, that in unfavourable

seasons, they are sometimes under the necessity of resorting to surface-sowing. *Mr Denny of Egmere in Norfolk*, states, "That at times, every practical farmer will admit, that a good seedsman may be employed to advantage, more especially in a backward season; if *flag-land*, (or clover layer,) the common harrow to follow; if *broken* (or cultivated) soil, ploughing under. In a wet time, he prefers sowing barley broad-cast, and to harrow in, or plough under, as the state of the soil best admits of." See also Mr Grove's Letter, dated 18th October 1819, (Farmer's Journal).

100 Communications from the Rev. Thomas Radcliff. This machine has lately come into considerable use in Ireland.

101 This seems to be a most tedious process. Why should not the plough be followed by a small drill barrow, or such a barrow attached to the plough itself, which would at once introduce the row culture, into all the districts where the seed is covered by a furrow?

102 It is much to be regretted, that fallowing is far from being, in general, *properly conducted*, in the open fields of England. Two ploughings, or at the utmost three, besides the seeding earth, is all that is given. It is not to be wondered at, that deficient crops should be produced by such imperfect tillage. The land, though fallowed, is generally foul, because the land is not brought into a pulverized state sufficiently early to promote the germination of annual weeds, and to facilitate their destruction.

103 Extracted from the communication of Thomas Greg, Esq. of Coles, in Hertfordshire to the Author, dated 7th January 1819. The above is a description of the *ploughing-in* system, when executed in the best manner; but unfortunately, that is far from being generally the case.

104 Engravings of these ancient machines, are inserted in the Communications to the Board of Agriculture, vol. i. p. 352.

105 It appears from the London Philosophical Transactions, (Lowthorp's Abridgment, vol. ii. p. 738), that the Spanish "*Sembrador*," or drill machine, was invented by a Spaniard, prior to the year 1663; and arguments, similar to those which are now used in favour of drilling, were urged in its behalf.

106 An experiment was tried between the drill and broad-cast husbandry, in the cultivation of beans, by M. Anguste Weiland of Ostend. He dedicated eighty French *ares* of land for that purpose, one-half of which was sown broad-cast, and the other half drilled. Besides a considerable saving of seed, there was an increase of produce on the drilled part, in the proportion of eleven to nine. Next year the same field was sown with barley, when the produce on the drilled part was likewise increased as 34 to 27. See *Radcliff's Report of the Agriculture of Flanders*, p. 10.

107 Communication from Mr John Shirreff.

108 The drills of potatoes are in general much too close. In Ireland, $3\frac{1}{2}$ feet is recommended.

109 Phytologia, p. 441.

110 Amos on Drill Husbandry, p. 190.

111 Peas are sown at Holkham, by the common nine inch interval drill machine, having every third coulter and seed pipe taken out. The rows are consequently placed alternately 9 and 18 inches apart. In the last cleaning operation the earthing horse-hoe is used in the 18 inch intervals. It presses the plants close together in the 9 inch intervals, and earths them up as one row. A field so cultivated, has a neat, clean, garden-like appearance, and generally produces a good crop.

112 General Report of Scotland, vol. i. p. 529. Mr Blaikie strongly recommends, that the rows of peas and beans should be drawn north and south, or as near that direction as possible, so that both sides of the rows may derive equal advantage from the sun rays. The crop may be expected to be proportionably greater, to ripen earlier, and more regularly than when the rows range east and west. Pease and beans cannot well be sown too early in the season, as late

sown crops are liable to be attacked, and greatly injured, by the smother-fly and other insects.

113 Kent Report, p. 107.

114 Communication from John Middleton, Esq.

115 This objection is obviated, by an addition to the machinery. The seed-box is fastened on a pivot, or by a screw, and the position of the box is adjusted to the ascent or descent, without any difficulty.

116 Communication from Mr Blaikie, at Holkham. Yet, *in very poor soils*, it may be expedient to try the effect of earthing up, with wider intervals, so that the hoeing will not injure the surface roots. In rich soils, it would be decidedly injurious. It was only on that point that the Author entertained any doubt as to the utility of drilling, which the new practice of avoiding earthing up has removed.

117 Remark by Edward Burroughs, Esq.

118 It is a great advantage to place the seed at a proper depth, so as to secure a sufficient degree of moisture to promote germination; and to make this deposition uniform, that the grain may spring and ripen more equally.

119 Dickson's Husbandry, vol. i. p. 456.

120 This is an advantage peculiar to drilling, for when crops are *ploughed in*, some of the seed will go to the bottom of the furrow, some will be left half way, and some will even be left at the top. In fact, the depth of seed, when ploughed in, unless well executed, is often more irregular than when harrowed in.—*Remark by Mr Wilkie of Wimpole.*

121 On a field sown in drills 12 inches apart, which received one hoeing in spring, a more productive crop, and by far more valuable grain was raised, than on a broad-cast crop, which had received three times the quantity of dung. The manure for the drilled crop of wheat, was applied in drills made by the plough, the seed sown, and then harrowed down.—*Remark by Edward Burroughs, Esq.*

122 Communication from J. C. Curwen, Esq. M. P.

123 Mr Blaikie, at Holkham, states, that it is no uncommon circumstance, to have from inferior land in Norfolk, rented only at from 15s. to 30s. per acre, as much produce as from land, that, in other districts, pays from L.5 to L.6 per acre. From land of an inferior quality, paying only 20s. for rent, and 5s. for tithe, 41 bushels of wheat per acre have been obtained, under the drill system.

124 It is absurd to suppose, that the access of *air*, so essential to the growth and health of plants, should not be of service to the roots of plants, if means could be contrived, (as is the case under the drill system), by which its access can be obtained. Where soils are *very poor*, the plan adopted in the cultivation of turnips, ought to be extended to grain, that of placing the manure, in the centre of a drill, and sowing the grain above it.

125 This has been doubted, but the drillists are in this point supported by respectable authority: the Rev. Adam Dickson, in his Treatise on Agriculture, vol. ii. p. 61 and 62, remarks, "That weeds keep the air from the roots of corn, and thereby expose it to be lodged." He observes, in another place, "That when corn is sown in rows, with intervals, the admission of air strengthens the stalks, which prevents the corn from lodging," vol. i. p. 526. Besides, it is well known, that when corn is lodged, it suffers less, if it has been drilled, than the broad-cast, there being, between the rows, an admission of air, which tends to dry the stems, and to render it sooner fit for being harvested.

126 Husbandry of Scotland, vol. i. p. 347.

127 Drilling was also considered to be greatly superior to broad-cast, when the seed was sown in windy weather; but machines have been invented, by which grain may be scattered over the surface with regularity and safety, whatever the state of the weather may be.

128 Many practical agriculturists, however, warmly oppose the universal

application of this doctrine, more especially in regard to rich and mellow soils. It is justified, however, by the following remark by the Rev. Adam Dickson, a clergyman in East-Lothian, who published in 1788, an Account of the Husbandry of the Ancients, in which, (vol. i. p. 526), there is the following paragraph: "Plants of corn, to a certain number, placed near to each other, instead of being weakened, are thereby strengthened. It is an advantage, therefore, to sow corn, either in broad rows, or where the rows are narrow, *very thick*, provided there are sufficient intervals to admit the *air*, and to give the plants room to extend their roots."—One would think, that this intelligent author, had foreseen the system of the Holkham school, as to thick sowing.

129 The following is an account of a most important experiment tried by John Brodie, Esq. of Scoughall, in East-Lothian: Ann. $18\frac{15}{16}$, he drilled in all about 150 Scotch, or 180 English acres, with wheat. The soil principally consisted of light loam, much subject to annual weeds. On comparing the produce on that soil, the broad-cast produced only 35 Winchester bushels per acre, the drilled 42; but as the broad-cast weighed 66lbs. per firlot, the drilled only 65, the difference in favour of the drill, is as 41 to 34. By hoeing the drilled crop, great vigour was given to the young crops of wheat. All the weeds of the mustard tribe, were as carefully taken out of the broad-cast crop, as out of the drilled, but the smaller weeds could not be equally well extirpated in the broad-cast. The grass seeds sown with the drilled crops answered better than with the broad-cast, owing to the ground being effectually cleansed of weeds by the hoeing; whereas, under the broad-cast system, grass-seeds, even after they have come up, are frequently injured by small weeds, which could not be got at when the ground was covered with a broad-cast crop. Mr Brodie, who is perhaps the greatest arable farmer in Europe, paying of rent, about L.7000 per annum, states, in a recent communication to the Author, that he continues to drill every year, and that he is convinced his crops are benefited by the practice.

130 Communication from Mr Blaikie, at Holkham. Mr Checkett, an eminent farmer of Belgrave-hall, near Leicester, states, that he has raised fifty bushels per acre, by the drill; but never more than forty bushels by sowing broad-cast.

131 Dr Rigby's Report, p. 18. This is the greatest improvement that has taken place in the drilling system; for it was *the earthing up, in rich soils*, which rendered the crops too luxuriant, and consequently unproductive. The great quantity of seed sown at Holkham, has the effect of preventing tillering; the ears thus become ripe, *at nearly the same period of time*, and thus a sample *equally ripe*, is produced, in which respect, drilled corn is sometimes deficient, when a small quantity of seed is sown. Tillering ought as much as possible, to be avoided.

132 The crop of barley is sometimes so strong, that if a hat is thrown into a field, it rests on the surface. This is called *hat-barley*.—*Young's Norfolk*, p. 251.

133 It is observed, that on light soils, short ears of wheat are the most productive, and that the sample is most uniform and weighty. In barley, long ears are preferred.

134 Young's Norfolk, p. 246.

135 "*The inverted hoe*," is so called, from the shares being turned inwards, and placed something in the form of a cock's spur. This hoe, it is said, far surpasses any other now in use, being worked with perfect safety between rows of plants, while in their infancy, even as soon as they appear above ground; and it effectually cuts up all weeds between the rows. It is well calculated for a potatoe crop, sown in ridges, being less likely to injure the fibres of the plant. The inverted hoes are of two descriptions; one is adapted for clearing between the rows of plants, either at wide or narrow intervals, *sown upon the flat*; the other at wide or narrow intervals, *upon the ridge*.

136 This would be a sufficient answer to the objection on the score of a scarcity of labourers, to carry on the drill system.

137 Communication from the late Arthur Young, Esq. Husbandry of Scotland, vol. ii. Appendix, p. 66.

138 Dickson's Husbandry, vol. i. p. 401.

139 A machine is invented by " *Plenty*," an agricultural engineer, which operates by *pressure*, and makes two drills at once, by one horse, which is likewise well calculated for light soils.

140 The mode of ribbing wheat, first occurred to the Rev. Adam Dickson, in the course of his examining the Husbandry of the Ancients. He describes the first trial of it, in the following terms: " A field having been prepared " for the seed-furrow was ribbed across, each rib being formed by one *bout*, " or veering of the plough, throwing two furrows upon, or towards each other. " In this situation the field was sown, and the corn appeared in distinct rows, " at about 14 inches distance the one from the other. The field was twice " hand-hoed, and produced a very good crop."—*Dickson's Husbandry of the Ancients*, vol. i. p. 523, note.

141 Mr Morton, of Leith-Walk, Edinburgh, has a machine in contemplation, by which several ribs will be made at once, and the process will be rendered nearly as expeditious as drilling.

142 In the Appendix, will be found, an account of the advantages of the drill-barrow, accompanied by an engraving and description, by which any workman, accustomed to agricultural machines, will be able to make one.

143 Young's Essex, vol. i. p. 100. By destroying weeds, the nourishment they would have absorbed, is preserved in the soil.

144 The following are the Resolutions on the subject of Drilling, which the Author moved, at a great agricultural meeting held at Holkham in July 1819, where they met with the cordial approbation and concurrence of above 500 practical farmers there assembled:

Resolved, 1. That the drill, or row system, is admirably calculated for the culture of leguminous and other crops, not strictly culmiferous, exposing more surface to atmospheric influence; carrying off, where the ridges are raised, any superabundant moisture in wet soils; and admitting the soil to be cleared of weeds in the simplest manner, and at the smallest expense; while the several plants cultivated, are benefited and improved by the repeated stirrings given to the soil, during the several processes.

2. That the drilling of culmiferous, or corn crops, when conducted with skill and attention, is a practice highly meritorious, as the seed may thus be deposited in the soil at the most desirable depth, and of an equal depth, by which the growth of the crop is considerably promoted; and as the crop can afterwards be improved in its progress to maturity.

3. That on all lands where weeds are abundant, corn crops may be drilled with peculiar advantage, for the purpose of cleansing the land more effectually, and at a cheaper rate, than hand-hoeing and hand-weeding broad-cast crops. That lands of moderate or inferior quality, will thus yield a greater produce, and may be brought more nearly on a footing with fertile land, than under the broad-cast system. Hence, that drilling corn crops, in such soils, cannot be too strongly recommended, as a most important national object.

145 Dibbling is much practised in China, with a view of saving seed; and it is said in a recent publication, (Storch's Cours d'Economie Politique, vol. iv. p. 72, and vol. vi. p. 15), that the saving thus effected in China, would feed a large proportion of the people of England.

146 Mr Blaikie remarks, that it is certainly an advantageous mode of putting in wheat seed upon very light land, *thick planted with couch-grass roots.* When such land is sown with wheat, it is usually after a one or two years' clover layer, either sheep-folded, or otherwise manured,—and ploughed only once. The furrow slice of flag, or turf, being laid flat on its back, is afterwards closely rolled

down; and the treading of the labourers' feet in carrying on the dibbling operation, is beneficial by consolidating the ground. The seed is covered in the dibble holes, by a bush harrow dragged over the surface. The foul turf is not broken in any way, nor the couch-grass roots cut in pieces, and transplanted as they would be, by the operation of the harrows, if such land was prepared to be sown by the drill machine.

147 Young's Essex, vol. i. p. 272.

148 Derbyshire Report, vol. ii. p. 98, and 133.

149 Middlesex Report, p. 190, 195.

150 Darwin's Phytologia, p. 291. See also Bogle's Essay in the Papers of the Bath Society, vol. iii. p. 494, and a Treatise on the Culture of Wheat, 1 vol. 8vo, printed anno 1812, p. 225. The plants from a peck of seed per acre, would be sufficient. The plants should be set at about five inches apart, in drills 14 inches asunder,—rolled with a moderate-sized machine,—horse-hoed when weeds appear, and afterwards earthed up with a double mould plough. The produce, when skilfully done, was at the rate of 44 Winchester bushels per statute acre, and the grain was plump and heavy. Ditto, p. 228.—In the Monthly Review for July 1796, p. 329, there is an account of a curious experiment in the transplantation of wheat. The effect of these operations, will appear in a striking point of view, from an experiment tried by Mr Charles Miller of Cambridge, recorded in the Philosophical Transactions, vol. lviii, p. 203. It is said that one plant, frequently replanted, ultimately produced 576,840 grains or pickles.

151 A successful experiment of transplanting wheat, was tried in Essex, an. 1797, taking up plants where they were too thick in a field, and dibbling them where too thin. *Essex Report*, vol. i. p. 282.—It was done in May, but would probably have been still more successful if executed in April, when the season was wet.

152 Coventry's Discourses, p. 71.

153 Sir John Anstruther's Remarks on the Drill Husbandry, p. 91.

154 Communication from the late Arthur Young, Esq. (dated Bradfield-Hall, Sept. 9. 1818), to the Author. Duckett considered hoeing necessary for the object of destroying weeds, but often hurtful in the application. If done on a sandy land, in hot sunshine, it would prove highly injurious to the crop. Where the soil is *hard* and *dry*, there is less risk of injury from the operation.

155 In Flanders, where the minutiæ of agriculture are so much attended to, it is not unusual, to tread fields of a moderate size, by the human feet; but this plan cannot be carried to any great extent. The superior sample obtained from the dibble, compared to the drill, is by some attributed to the additional solidity the land receives from the treading of the children employed in the operation.

156 Marshall's Southern Counties, vol. ii. p. 329.

157 Bedfordshire Report, p. 373.

158 Marshall's Southern Counties, vol. i. p. 174.—He adds, that the advantages of this practice are so great in light soils, in dry seasons, that it would be worth while, in many cases, to be at the expense of an additional horse and driver, in countries where two horses a-breast are the ordinary team, to have the land thus compressed.

159 Treading by sheep, or other stock, would be a more effectual mode of destroying slugs, or the wire-worm, than even rolling. The head-lands, upon which the horses have turned, and where the earth is compressed, are in general free from damage. It is in hollows, therefore, where the slug is sheltered and breeds, and the remedy is to be found, *in pressure*, either by a heavy roller, or, still better, by the tread of animals.

160 This observation is very applicable to the Irish farmer, who seldom attends to *minutiæ* in any branch of his business. This is a very unfortunate fact, as it is by attending to minor matters, that the husbandman, and even the cot-

tager, derive their principal sources of profit. It is in vain to cultivate well, if the corn is not afterwards attended to, and protected from trespass; neither of which, the Irish farmer thinks of doing effectually. Generally speaking, the industrious and assiduous husbandman, will find a source of emolument by attending to objects, from which the indolent and ignorant occupier, would not think of deriving any advantage.—*Remark by Edward Burroughs, Esq.*

161 This sum is not to be considered a common expenditure, but a peculiar and extraordinary case.

162 Essex Report, vol. i. p. 306. Mr Blaikie remarks, that thick plants of wheat, are generally benefited, by hoeing, if done early in the season. But it is a dangerous practice to hoe thin plants of wheat at any time. It is impossible to perform the operation without cutting up some of the plants, and smothering others with earth drawn upon them by the hoes, which makes bad worse as to the set of plants; and stirring the soil in such cases, causes an exuberant growth in the plants, and consequently mildew in the crop. It is a better method to well roll thin plants of wheat early in the spring, and afterwards pull out seeding-weeds by hand, in preference to using the hoe.

163 Gloucestershire Report, p. 115, &c.—Similar practices are adopted with success in several other districts. Perhaps were more attention paid to the preparatory processes, or, were the fallowing system adopted, there would be less occasion to work the land, after the crop was above ground. But above all, by the adoption of the "*Drilling system,*" such tedious processes might be avoided.

164 Marshall's Gloucestershire, p. 91, and 100.

165 Middlesex Report, p. 213.

166 Middlesex Report, p. 213.—On the naked chalk soils about Dunstable, this is beneficially practised with sheep, and sometimes with swine.—*Bedfordshire Report*, p. 373.

167 Herts Report, p. 85.

168 Middlesex Report, p. 213.

169 Some sorts of sheep, particularly wedders, do not agree with such succulent food as young corn.

170 It was tried more than forty years ago in Oxfordshire. Mr John Blackwall, an intelligent farmer in Derbyshire, has long practised this mode with great success. *Report*, vol. ii. p. 133.—The same plan of topping, may be extended to pease, with much advantage, for the purpose of accelerating their ripeness.

171 Nothing, perhaps, would be of more importance, in the cultivation of the clay soils of Britain, than a variety of beans, that would ripen a month or six weeks earlier than the present kind. It would be useful to see some account of any trials that have been made for that purpose. Mr Burrell, member for Sussex, and Mr Stone of Basildon, in Berks, strongly recommend the Heligoland bean, as both early and productive, and more easily harvested in a wet season. By others, the superiority of this bean is, however, disputed. A species of bean, that will stand even the severity of winter, has likewise been tried in Essex and other districts, but has not yet been extensively cultivated.

172 Vol. i. p. 522.

173 Mr Coke cuts down his wheat very early, even when the ear and stem are greenish, and the grain not hard. He says that the wheat, thus early reaped, is always his best sample, and he gets 2s. a quarter for it more than for wheat cut in a more mature state. He perhaps, loses something in the measure, the skin being thinner, and the grain probably, not quite so bulky; but, if this be true, it is fully compensated from his suffering no loss by shedding on the ground, which, when the ear is ripe, and the weather windy, is often not inconsiderable.—*Dr Rigby's Report*, p. 29.

174 Brown's Rural Affairs, vol. ii. p. 310.—Young's Calendar, p. 420.—

Whenever the greater proportion of the crop is fully ripe, no delay in cutting it should take place, more especially if the season is advanced, or the corn is in a high and exposed situation. In such circumstances, the green may never ripen, and the ripe may be lost.

175 An experienced farmer, the late Mr John Shirreff, recommended, that all sorts of grain should be cut, whenever the straw immediately below the ears is so dry, that on twisting it, no juice can be expressed; for then the grain cannot improve, as the circulation of the juices to the ear is stopped. It matters not that the stalk below is green. Every hour that the grain stands uncut, after passing this stage, is attended with loss.

176 Paper from Mr John Shirreff, Comm. vol. iv. p. 172.

177 Curwen's Report, p. 72.

178 Sometimes the crop is pulled up by the roots, where long straw is much wanted, as is the case in the western counties of England; and beans are occasionally pulled, where the pods are lowly situated. But these practices are considered to be tedious and expensive.

179 An improved implement for cutting corn, one half from the point backed like a sickle, and the remainder smooth and sharp, was invented by Mr Joseph Hatton junior; and effecting a great saving of corn, has had a considerable sale.—See Transactions of the Society of Arts, vol. xxviii. p. 54; Derbyshire Report, vol. ii. p. 122.

182 Gentleman Farmer, p. 161. In Norfolk the corn is laid in swarth, it is gathered up by hand, and loosely bound in sheaves or bundles, tied with one band near the top, and set up in stocks or shocks, but not hooded. The ground is all raked over, and the rakings put into the sheaves as the work proceeds. Mown wheat is seldom much injured in the shock, by wet weather, for although it is soon wet, it is also soon dry again. It stands so loose and open in the sheaf and shock, that the sun and wind dries it thoroughly, inside and out, in half the time required for drying close bound reaped corn under similar circumstances. The objections to mowing wheat are, That it has a slovenly appearance in the field, and is more liable to damage in unfavourable weather.

183 General Report of Scotland, vol. i. p. 384.

184 General Report, vol. i. p. 386. A crop of oats, if abundant, takes longer time to cut with a sickle, than a crop of wheat, if it is cut low; there being more handfuls of oats than of wheat.

185 Devon Report, p. 142. It is said, that in some parts of England, barley may be mown, at from 3s. 6d. to 5s. per acre; but that is independent of tying.

186 Middlesex Report, p. 152.

187 Surrey Report, p. 215.

188 Communication from Mr John Hope, a native of East-Lothian, to the Author. This shews the advantage of minute and extensive inquiries. One would not have expected, that so perfect a system of reaping would be practised, by the natives of a remote and mountainous district, as that of Cardigan. See also the Herefordshire Report, p. 49.

189 Chap. II. p. 117. It was described as far back as the year 1763, in the Gentleman's Magazine, p. 528.

190 Marshall's Southern Counties, vol. ii. p. 25 and 28.

191 Robert Browne, Esq. of Markle.

192 In one year he erected 144 stacks in the field. *Report*, p. 74.

193 The comparative advantages of using carts or waggons, for conveying corn in harvest, has been already discussed. See Chap. II. p. 123.

194 Curwen's Report, p. 76.

195 See a description of those at Woburn Abbey. Communications to the Board of Agriculture, vol. i. p. 72. When built with brick, the stacks are kept down, and hold more corn in the same height than the other sorts; conse-

quently, they claim a preference in exposed situations. They will not admit, however, the plan of bosses; and are sometimes damp, from the rain water they receive before harvest. To obviate that objection, ricks are sometimes built on solid masses of stone, instead of being hollow.—*Derbyshire Report*, vol. ii. p. 67.

196 For *ricks*, or long square stacks, the number must be even; the practice of building these, called *wheat-hovels* in Lincolnshire, is very ancient; their posts are of stone, and covered with a stone cap, on which the timber rests.

197 Husbandry of Scotland, vol. i. p. 373.

198 Coventry's Discourses, p. 85.—The pleasures of the harvest, is thus ably, and eloquently depicted by Mr Curwen: " I was never absent from the harvest-field an hour from its commencement to its conclusion; for, independently of all other considerations, there is a gaiety in it, which is delightful, and peculiar to itself. The successful termination of the labours of the year;—the recompense of unwearied exertion;—the alleviation of solicitude;—the solace of hope;—all combine to inspire the liveliest gratitude to Heaven;—to call forth the sensibilities of the human heart, and to kindle the best feelings of nature; whilst the responsive notes of the motley group, reiterate mutual good-will, universal sympathy, and thankfulness to Providence!"—*Curwen's Report*, p. 74.

199 In 1795, owing to the badness of the crop, some farmers paid 10s. per quarter for thrashing wheat. *Kent Report*, p. 190.—In 1807, thrashing wheat, cost in Essex, 4s. per quarter. *Report*, vol. ii. p. 371.—In the winter of 1815-16, the price in Surrey was from 8s. to 9s. per quarter. But the price of labour is so involved with the poor-rates in England, that it is difficult to ascertain its real amount.

200 Brown's Treatise on Rural Affairs, vol. i. p. 315.

201 Middlesex Report, p. 548.

202 Roxburghshire Report, p. 58.

203 Somerset Report, p. 97.

204 Devonshire Report, p. 149.—The small mill invented by Mr William Johnstone, of Langholme, in Dumfriesshire, which costs only from ten to eighteen pounds, would be a valuable improvement to those western districts; for by it the ears might be thrashed, without separating the ears from the straw, merely inserting the heads of the sheaves; and the straw would remain unbruised. This mill is more likely to be adopted in foreign countries, than the larger machines. It is likewise to be had at Gutzmer's, Leith Walk, Edinburgh. Baron Silvestre has likewise invented a hand thrashing-mill, which saves the straw whole, and is recommended for its simplicity.

205 Roxburghshire Report, p. 59.

206 Brown's Treatise, vol. i. p. 356.

207 General Report of Scotland, vol. i. p. 409.

208 A Letter to the Right Hon. Sir Joseph Banks, Bart. by Charles Hatchett, Esq. Printed an. 1816, in 4to.

209 Husbandry of Scotland, vol. i. p. 377.—The corporation of bakers at Perth, have a machine for that sole purpose.

210 It may likewise be made into what are called *flour scones* in Scotland, prepared with milk instead of water, a species of bread, which is both good and palatable.

211 Instruction sur les moyens de tirer le meilleur parti possible des grains cereales, &c. Redigée par ordre du Ministre de l'Interieur, par une Commission de la Societé Royale et Centrale d'Agriculture. *Paris, le* 18 *Juin*, 1817.—The Government of France does itself infinite credit, by its attention to such objects, and the useful information which it circulates.

212 In the first volume of the collection of printed papers, known under the name of " *De Re Rustica*," p. 118, there is an account of a treatise on the

construction of granaries, by a Hanoverian architect, called Dinglinger, which merits attention. It is accompanied by an engraving. In the works of Dumonceau, Duhamel, and Chateauvieux, there are descriptions of a ventilating granary, which is much recommended; and M. Descroizilles, *ainé*, has lately published a work at Paris, explaining a new mode of preserving grain, in what he calls "*conservatory towers*," invented by M. Chenest, which has received the approbation of the Royal Agricultural Society of Paris.

213 Red oats, producing perhaps seven quarters per acre, will often yield much less straw than Angus oats, which may produce only five quarters of grain.

214 In Middlesex, wheat is cut so close to the ground, as to add 7s. per acre to the value of the straw. *Report*, p. 172.—Near London, where the wheat is bagged, the marketable straw, which yields one Winchester bushel of wheat, averages about three truss, of 36 lbs. each. The yield of wheat in all England, is supposed to average nearly 24 bushels; which, multiplied by three, produces 72 truss of straw, per English acre. One load of straw in the London market is 36 truss, and that is the produce of half an acre; therefore an acre produces two such loads of marketable straw, and as each load weighs 11 cwt. 2 qrs. 8 lb., the two loads, or one acre of straw, weigh 23 hundred weight of 112 lbs. each, and 16 pounds. If to this should be added, for short straw, chaff and stubble, nearly three hundred weight, the result will be 26 hundred weight per acre. Twenty-four bushels of wheat, of 60 lbs. each, is equal to 12 cwt. 3 qrs. 12 lbs. per acre, of clean marketable corn. Add the weight of the straw, &c. 26 cwt. to that of the corn, nearly 13 cwt. and we have 39 cwt. as the whole crop. The variations for all England, are from one-half to double these amounts, or from one ton to four. *Communications by John Middleton, Esq.*

215 Dr Skene Keith remarks, that though barley has the least weight of straw, it has a considerable proportion of chaff and light corn.

216 In Flanders the weight and value of the different sorts of straw per English acre, is estimated as follows:

Crops.	*Quantity of Straw.*	*Price.*	*Total value.*		
Rye,	4000 lb.	one-fourth of a penny,	£.4	3	4
Wheat,	3000 lb.	one-fourth,	3	2	6
Oats,	3000 lb.	one-eighth,	1	11	3
Barley,	1500 lb.	one-eighth,	0	15	7½

217 About Dunstable, Luton, and other places in the Chiltern range of chalky hills, (where the whitest straw is produced,) very important profits are derived, from the sale of the *top joint* of the straw of wheat, to persons who come to the farmers' barns, to draw out, and cut off this part of the straw, tying it into short bundles, which sell, by the pound, to the plaiters.

218 Oxford Report, p. 153, 22½ cwt.

219 Middlesex Report, p. 176, note. L.7, 4s. per English acre.

220 Communication from Dr Skene Keith. In any year in which fodder is plentiful, little more than L.1 can be got for an acre of straw; but before the introduction of the turnip husbandry, when fodder was scarce, and hay from sown grasses unknown, from L.2 to L.3, was the price in Aberdeenshire.

221 It is evident, that the MONEY VALUE of the straw, cannot be charged, according to the prices specified in the text, to farmers in general, because most of them are prohibited from selling or disposing of it, and it is essential to them for preserving the fertility of their land. But in a national point of view, the value of the straw is to be included among that of other agricultural productions. On this subject, Mr Holdich remarks, that all straw, hay, and vegetables, consumed by cattle, are to be estimated in the cattle only which come

to market; and not separately by themselves, which would be to reckon them twice. Seed-*corn* and *manure*, also, butter, cheese, bacon, &c. *consumed by farmers' families*, are to be considered, like the soil itself, as necessary adjuncts to cultivation. Implements of husbandry, wear and tear, fences and drainage, are to be *deducted* in a national view, from *the produce of the soil;* so likewise are all expenses in *purchased manure*, excepting when the sale of the straw pays for it. When hay is sold, manure is bought; and the *difference* only, in both cases, ought to be carried to the credit of the account.

222 It would be advisable, when barley and clover are sown and cut together, to bind the sheaves, and to stook the corn for some days, until the bottom of the sheaves are soaked and withered. By this means, the clover will retain its succulency, and the straw will imbibe the nutritious properties of the clover.

223 Both bean and pease straw will give some horses colic pains. Half an ounce, or a table spoonful of laudanum, with four ounces of castor-oil, or three table spoonfuls of turpentine, will remove the complaint; to be applied a second time, if the first is not effectual.

224 The haum of white pease is esteemed very proper for sheep on turnips. It prevents scowering, and in that respect contributes to preserve them in good health. In many districts, it is much used for that purpose. *Communication from John Middleton, Esq.*—If pease straw has not been well harvested, it ought to be kept till the succeeding season after it was cut.

225 When tares are permitted to ripen their seed, the weight of the crop is considerably reduced, but its money value is increased. The clean tares are generally from twenty to thirty bushels, but in that state the haum is only from one to two tons per acre. *Communication from John Middleton, Esq.*

226 Tares produce but a light return on poor or sandy soils, unless well prepared for that crop. But on loams, or strong clay, they may be sown with one ploughing after wheat, with every prospect of success. In many cases, cattle have preferred the haum of tares, to hay given them after the seed was thrashed out. *Remark by Edward Burroughs, Esq.*

227 Middlesex Report.

228 It is stated in Young's Essex, that sheep are fonder of pease straw than of hay.

229 Remark by Edward Burroughs, Esq.—Hogs are likewise very fond of pease straw.

230 Cours Complet d'Agriculture, par Rozier. Vide *Paille.*

231 When such mixtures of dry straw, and green clover, are properly made up, and of sound materials, they may be kept as stores, to supply fodder in years when the crop fails. What is stored up in harvest, may either be eaten next winter, and a new store formed to meet a scarcity: or even the former mixture, if not needed, may be renovated by a farther mixture of clover, and in that way it may be preserved in good condition for several years.

232 It is found by experience, that store stock do very well upon straw, till some time after Candlemas; but when the days get longer, and drying winds come on, they should have either succulent food, in small quantities, or a little hay, though of inferior quality.

233 Middlesex Report, p. 220. This may be owing to the wheat sown early being more ripe.

234 Dickson's Husbandry of the Ancients, vol. ii. p. 409.

235 Middlesex Report, p. 175.

236 Dickson's Husbandry of the Ancients, vol. ii. p. 408.

237 Middlesex Report, p. 328.

238 Derbyshire Report, vol. ii. p. 186; and vol. iii. p. 23.

239 This is according to the practice of the farmers in the Lothians. In some districts of England, they maintain, that a ton of straw, when converted into dung, would be reduced to half a ton in weight. But it is evident, that straw mixed with the dung, and saturated with the urine of cattle, must be much heavier than in its dry state.

240 In the county of Somerset, wheat is seldom thrashed with the straw, but the ears are cut off, and the straws, which are bound in sheaves, tied very tight, are used for thatching.—*Somerset Report*, p. 97, 98.

241 Young's Norfolk, p. 300.—It is calculated that this mode of using stubble, unless there is an absolute want of litter, will never pay the expense; for estimating the quantity of stubble got, at seven, or eight cwt. per acre, this weight of straw, of the best quality, could be bought for less money than what it would cost to mow, and carry home the same quantity of stubble. Besides, there is little doubt, that the soil would be thereby deprived, of a portion of manure, and of vegetable matter, by which it would be benefited.—*Remark by Edward Burroughs, Esq.*

242 This was an ancient practice:—See Virgil's Georgics, i. v. 84; and is mentioned in Scripture, Isaiah, chap. v. ver. 24. Obadiah, v. 18.

243 Essex Report, vol. i. p. 325.

244 Huntingdonshire Report, p. 128.

245 Derbyshire Report, vol. ii. p. 124.

246 Marshall's Southern Districts, vol. i. p. 61, 78.

247 South Wales Report, vol. i. p. 428.

248 Ditto, p. 341.

249 Young's Calendar, p. 503; Derbyshire Report, vol. ii. p. 307, note.

250 Coventry's Discourses, p. 91, note. What an improvement on the old system in Scotland, of *infield* and outfield, the former of which got all the manure, and the latter was very imperfectly cultivated, whereas the whole farm is now cultivated, as much as circumstances will admit of, on the same system.

256 ~~251~~ See an important communication on that subject, by Francis Blaikie, Esq. Addenda, No. V.

251 Vanderstraeten's Improved Agriculture, p. 36. The more valuable crops are, 1. Flax; 2. Hemp; 3. Cole-seed, and, 4. Potatoes. Rape for seed is much grown. Besides other advantages, the farmers thus supply themselves with oil for their lamps, and have their light at a trifling expense.

252 Cabbages succeed best on grounds which are too rich for either turnips or potatoes. They are apt to be injured by frost; and in cold districts, therefore, they ought to be consumed early in the season. Cabbages require so much manure, that they can be raised with advantage only in places where plenty of dung can easily be obtained. They are rarely, on that account, included in common rotations.

253 Remark by John Middleton, Esq.

254 Derbyshire Report, vol. ii. p. 103.

255 ~~256~~ Communication from John Middleton, Esq.—In places at a considerable distance from a large market town, 1. Winter tares; 2. Wheat; and, 3, Clover, make an advisable mode of cropping, on strong land, in a climate where winter tares can be successfully cultivated. *Ditto.*

257 Communication from John Middleton, Esq.

258 In regard to winter wheat sown in spring, *after turnips*, an experienced farmer in East-Lothian, (Mr Dudgeon of Prora,) observes, that it may be safely sown as late as the middle of March, and even later; and that on fine land, it is frequently grown, in preference either to barley or oats, if sheep have eaten the turnips upon the ground, which is the most valuable, and the least expensive method of using the turnip crop. But good land, by this scheme, would be over dunged, were it not for the practice adopted, of stripping out a part of the turnips, to the amount of one-fourth, one-third, or even one-half, (leaving the alternate rows,) and carrying those drawn out to be used by cattle. When a certain breadth is thus stripped, the hurdles can be set upon the drills which remain, and the stripping be carried on as the sheep may require more ground.

259 Mr Rennie of Phantassie, and Mr Brown of Markle, in East-Lothian. In the Derbyshire Report, vol. ii. p. 104, the same course is recommended. By the profits resulting from the adoption of that rotation, an active and in-

telligent farmer, (John Tennant, Esq. of Girvan Mains, in Ayrshire,) has gradually been enabled to stock three different farms; and beginning with a rent of only L.50 *per annum*, he now annually pays L.2700, or *fifty-four times* the sum which he originally paid when he commenced farming. There can hardly be a stronger argument in favour of that system, where the soil will bear it.

260 Communication from William Hunter, Esq. of Tynefield, in East-Lothian.

261 Communication from William Hume, Esq.

262 Yet in Northumberland, one of its most intelligent farmers, Mr Bailey of Chillingham, states, that clover almost universally fails after wheat and potatoes, and the same has been found in Roxburghshire. Perhaps a sufficient quantity of manure, with two such scourging crops, had not been applied. An experiment was tried in Ireland, to ascertain, whether potatoes are an exhausting crop or not. Four acres of land were equally well prepared, on two of which potatoes were planted with dung, which produced a good crop. The other two were fallowed, and dunged in the same proportion as the potatoe ground. Both were sown with wheat at the same time, when, to the surprise of every one, the potatoe ground produced the best crop of corn. There can be no doubt, that dung is brought into a more perfect state of putrefaction by being previously applied to a green crop, and more especially under a crop of potatoes, as it has the advantage of being effectually blended with the soil. The tops of the potatoes are also peculiarly fertilizing; and from shedding their decayed leaves, and excluding the surface of the soil from incessant heat, a quantity of vegetable mould is created on its surface. Hence it is, that the best crops of wheat have been produced, where the crops of potatoes have been *the most luxuriant*. This experiment was tried at the Viscount de Vesci's, Queen's County, Ireland. *Communication from Edward Burroughs, Esq.*

263 Mr Curwen concurs in these sentiments. He remarks in his Report to the Workington Society, anno 1816, p. 103, that the first lesson in modern husbandry is, to correct and control too extensive ploughing, which is effectually done, by confining the tenant to alternate white and green crops. The proportion of green crops, with few exceptions, is too little, even in the best cultivated farms in this country. When this shall be fully understood, a great and essential point will be gained, and the progress of good husbandry will become very rapid.

264 The potatoe-oat would be the most productive, but the red oat is the best calculated for a peaty soil.

265 Mr Maxwell of Fletton, Huntingdonshire Report, p. 108. If the soil or climate is unfavourable to pulse crops, a second year of herbage would be preferable to beans or pease.

266 Northumberland Report, p. 185, note. The danger of having the land too fertile, particularly from the hazard of rust or mildew, has been long remarked. Ellis in his "Chiltern and Vale Farming explained," p. 200, has the following remark: "I also further prove, that these blights happen by the richness of the earth, and the wetness of the summer season; because the best wheat that England enjoyed this year, (ann. 1732,) grew on the poorest dry lands." When the straw is firm and compact, rust is seldom experienced; but when it is large and porous, and full of sap, it seldom escapes.

267 Middlesex Report, p. 183. Mr Greenhill of Stratford, in Essex, is said repeatedly to have had 600 acres of potatoes, 600 of wheat, and 600 of clover in one year, and thereby to have accumulated a large fortune. *Ditto.*—He had the good sense to discover, how much may be done by an intelligent farmer, who avails himself of the advantages which he may derive from being near a metropolis, or a great market town.

268 Mr Brown of Markle, in East-Lothian, has ascertained, that a pair of horses, properly fed, and regularly employed, under a judicious system, can carry on the cultivation of 50 English acres in a rotation of six; namely, 10 acres in fallow, or, on light soils, in turnips;—10 acres in wheat or barley, with either of

which grass-seeds should be sown;—10 acres in oats, after these grasses;—10 in beans in strong soils;—and 10 in wheat.

269 Suffolk Report, p. 51.

270 The same rotation answers on light gravelly soils.—*Derbyshire Report*, vol. ii. p. 104.

271 It is the practice in Northumberland and the Lothians, to sow the winter species of wheats, more especially on light, friable, and warm soils, as late as the end of February, and even the beginning or middle of March, after turnips; but barley is sown after turnips consumed at a later period.

272 The clover should be ploughed down before winter, and the oats sowed on the stale furrow, after being scarified. The stubbles should be *shimmed*, according to the Kentish practice, (see Chap. IV. Part I. Sect. 24), and the land ploughed as early as the season will admit of it, after the crop has been harvested.

273 Suffolk Report, p. 52, note. These protracted rotations, however, are much condemned by Mr Middleton, as tending to promote weeds and exhaustion. He is of opinion, that they occasion the necessity of fallow, and the erroneous idea, that it is generally advisable.

274 Brown's Treatise on Rural Affairs, vol. i. p. 464. The fallow, in this case, is only once in eight years.

275 General Report of Scotland, vol. i. p. 526.

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276 It would be more consistent with the principles of the alternate husbandry, to take a crop of oats after grass, and then pease or beans. See Brown's Rural Affairs, vol. ii. p. 74.

274 ~~277~~ Two crops in the same year, are not very uncommon near Edinburgh, early potatoes and turnips, being taken in the same year. Turnips may also be got after clover, especially when it has been cut for soiling.

278 Middlesex Report, p. 163.—In the southern parts of England, where the barley can be got off the ground in July, *transplanted Swedes* might be put in ground drilled to receive them, in the beginning of August, and the crop would be nearly as forward, as if they had been raised from the seed in May.

275 ~~279~~ Middlesex Report, p. 188. Mr Hutchins, and other farming gardeners in Kensington and Fulham, raise a succession of cabbages, and then potatoes or turnips the first year, and wheat the second year; and by repetition, they obtain these three valuable crops every two years.

277 ~~280~~ The variety called "*The stone turnip*," ought to be procured. A sandy loam is the soil where they thrive best. They should be sown very thick, *broadcast*, as soon as the land can be got into good tilth. The success of the crop principally depends upon the long continuance of mild and growing weather, in October, November and December. Crops of stubble turnips near London have produced L. 10 per acre, and upwards.—See *The Farmer's Journal*, published on the 13th September 1819.

278 ~~281~~ Hints on the Agricultural State of the Netherlands, p. 71. The second, and in some cases, the preparatary crops in Flanders, are estimated at the following sums, in English money, per statute acre:

	Sterling Money.		
Carrots after flax,	£.5	3	10
Spurrey after wheat,	6	2	0
Turnips after rye,	6	4	7
Turnips after oats,	6	4	7
Green corn, *before* flax,	2	10	0
Green corn, *before* potatoes, per English acre,	2	10	0

(*Vanderstraeten's Improved Agriculture*, p. 67).

Sometimes a farmer procures three crops in one year. 1. A crop of corn, to be cut green; 2. Flax, with which carrots are sown, or after the flax is pulled, turnips, spurrey, or buck-wheat. If potatoes begin the course, they are preceded by a crop of grain, to be eaten green. The corn must be sown in winter, and cut in the beginning of May, when the cattle are very fond of it, as other green crops are so scarce.—(Ditto, p. 58). After a crop of cole-seed, or hemp, spurrey, carrots, or turnips are grown, and after wheat, a crop of carrots, sown with the wheat, or spurrey, or turnips sown after the crop is reaped. Carrots are also sown with rye, or turnip, or spurrey, after the crop is cut down. It is indispensable to vary the immediate crops, and never to sow the same for two years in succession.—(*Vanderstraeten's Improved Husbandry*, p. 42). The moist climate, and mild winters of England and Ireland, are favourable to the plan of double crops.

280 ~~282~~ Communication from Edward Burroughs, Esq.

281 ~~283~~ Communication from Mr Church of Hitchill; Husbandry of Scotland, vol. i. p. 327. This idea was first suggested by Mr George Syme at Redkirk, near Annan.

282 ~~284~~ Communication from Mr Hunter of Tynefield; Husbandry of Scotland, vol. ii. Appendix, p. 52. This opinion is strongly confirmed by the authority of Mr Brown of Markle, who has, for several years, followed the practice recommended by Mr Hunter, with equal success.

283 ~~285~~ Where this plan is tried, the seed wheat ought to be brought from Berwickshire, or the Lothians, accustomed to that mode of culture. A greater quantity of seed should be used, than if sown in the autumn or winter months.

284 ~~286~~ A skilful farmer cultivates his wheat land in October; his beans in January; his oats in March; his barley in April and May; and his turnips in June or July; all with the same cattle.—*Gentleman Farmer*, p. 336.

285 ~~287~~ Mr Andrew of Tillilumb, near Perth, finds, that if clover be cultivated only once in eight years, the produce is not only nearly double, but that the succeeding crop of oats is better, by eight bushels per acre.

86 288 Middlesex Report, p. 196. For that purpose, tares and turnips, to succeed each other in the same year, are pre-eminent.

289 General Report of Scotland, vol. iii. p. 224. The advantages of this system are thus ably enforced by the intelligent Dr Coventry. By selecting the proper species of plants for culture, and pursuing a proper succession, and regular order in raising them, land may be kept in a constant state of fertility. In this way cultivators, in common situations, *who may not have an extraneous supply of manure*, are able to sustain, and even to increase the productiveness of their arable lands; while at the same time, the fullest effect is given to the manure, when applied, by the soil being retained in a proper state of texture and cleanness; some species and proportion of crops, being more deteriorating or hostile to good tilth and perfect cleanness, than others.—*Coventry's Discourses*, p. 37.

290 At the Author's particular request, Mr Falla tried an experiment, which has obviated a great difficulty in carrying on the trenching process *in strong land*, on a great scale. From its compactness and weight, it is difficult to trench clayey soils. It accidentally occurred to me, that this obstacle might be obviated, by employing two labourers, the one following the other. The first going 5 or 6 inches deep, and the second as much more. Mr Falla tried even young women on this plan, and successfully. They used light spades, $9\frac{3}{4}$ inches long and 8 inches broad, and weighing, with the handle, about $4\frac{1}{2}$ lbs. avoirdupois. The expense came to L.2 : 4 : 4 per acre; but, after a little practice, he thought it might be done cheaper.

287 291 Vanderstraeten's Improved Agriculture, p. 80, 82, and 84.

288 ~~292~~ His stock was two cows and two pigs; one of his cows had a summer's gait for twenty weeks with his landlord. The land was partly ploughed, and partly dug with the spade, cultivated (the ploughing excepted) by the man, his wife, and a girl about twelve years of age, in their *spare* hours from their daily *hired* work, seldom a whole day off, except in harvest—made the rent in butter, besides a little used in the family. The family lived well, and was able to lay out a handsome sum that had been yearly saved to place out two sons, and to supply them with clothes, washing, &c.

289 These discoveries were effected, under the patronage of that distinguished friend of agriculture, John, Duke of Bedford, by Mr George Sinclair, formerly gardener at Woburn Abbey, and are now exemplified at his nursery, New Cross, near Deptford, Surrey.

290 See an account of the results of experiments on the culture and nutritive properties of grasses and other plants, instituted by John Duke of Bedford, R. G. in *Hortus Gramineus Woburnensis*, 3d edit. Ridgway, London.

291 Messrs Howlan, at their Merino sheep farm in Ireland, have improved 200 acres, in the following manner: A horizontal drain was first formed, at a considerable elevation on the hill, and a corresponding one at the bottom. The intermediate space was scored with the plough merely, in such directions as to catch the oozing from the upper drain, (which cuts off the water from a peat bog at top), and to convey that, as well as the surface water, to the lower drain. Then, in perpendicular and parallel compartments of 12 acres each, they laid on rock lime, at the rate of 40 beer barrels, of 32 gallons each, per acre, which was done at 1s. per barrel, including carriage. This saved breaking up, and laying down, and produced an immediate and wholesome pasture. The lime caused the ground, though elevated, to yield white clover in abundance. Under this management, without the aid of turnips, the land carries three sheep per acre all the summer.—*Communication from the Rev. Thomas Radcliff.*

292 It is remarked that *hardy plants*, are of a coarser quality, more fibrous, less succulent, and less nutritious for live stock; but these ought to be avoided, even in upland and hilly countries, since the recent discoveries in the culture of grasses. See Addenda, No. II.

293 Near Buxton, on the Devonshire estate, 1500 bushels of powdered or slaked lime, per acre, have been applied to the surface. The expense was 2d. per bushel, including leading and spreading, The effect, though slow, was striking, the heath being exterminated by the lime, and succeeded by a sweet and good herbage.—*Derbyshire Report*, vol. ii. p. 437. Mr Graham of Limekilns limed on the surface a large tract of coarse moor land, between Glasgow and Kilmarnock, with much advantage; and there are millions of acres, in England, Scotland, and Ireland, now remaining in a neglected state, equally susceptible of the same improvement.

294 Communication from Mr Dawson of Graden; Farmer's Magazine for March 1812, p. 69.

295 Coventry's Discourses, p. 127.

296 It is printed in the third volume of the Communications to the Board.

297 Essay by Mr Bridge of Windford; Communications to the Board of Agriculture, vol. iii. p. 612.

298 Duckett's skim coulter plough does the same work, at one operation; but every farmer has not that tool in his possession; and as it requires four horses and two men, there is no saving in the use of it.

299 Young's Essay; Communications to the Board of Agriculture, vol. iii. p. 131.

300 Communication from Mr Holdich.

301 In Ireland, a quantity of limestone gravel answers the same purpose.—*Remark by Edward Burroughs, Esq.*

302 Communication from Mr Holdich.

303 Young's Essay; Communications to the Board of Agriculture, vol. iii. p. 142.

304 Remark by Edward Burroughs, Esq. This intelligent agriculturist has tried several experiments, which convince him, that sowing grass-seeds, without a crop of corn, is best calculated for the climate of Ireland, where there is such a risk, if the corn crop is very abundant, that it will be lodged in autumn.

305 The Rev. Dr Cartwright's Essay; Communications to the Board of Agriculture, vol. iii. p. 184.

306 Middlesex Report, p. 302.

307 Dr Singers's Agricultural Report of Dumfriesshire, p. 337.

308 This assertion is thus explained. In the course of years, on the surface of such a soil, there is formed a rich, light, black mould, two or three inches in thickness, which is the matrix of these rich grasses. When the soil is ploughed up, this valuable surface is mingled with the colder and less fertile strata below, and cannot be renewed for many years. *Young's Essay;* Communications, vol. iii. p. 191. It is contended, on the other hand, that strong clays improve, when first sown down with grass, and that by repeated trials, it has been completely ascertained, that such soils will yield as much grass the first year after they are sown, as in the two following years. Hence, instead of keeping them in grass, it is desirable, frequently to break them up, and to stock them with fresh plants.—*Communications from Robert Brown, Esq. of Markle.* But the question is, if a rich surface *has been got,* should it be destroyed?

309 Wilkes's Essay; Communications to the Board, vol. iii. p. 319.

310 Coventry's Discourses, p. 125, note; Wilkes of Measham's Essay, Communications, vol. iii. p. 319. In that kind of soil, no cracks or fissures are to be met with, even in the dryest summers.—*Lincoln Report,* p. 72.

311 Lincoln Report, p. 219. In the dairy, good grazing land will produce 5 cwt. of cheese per acre. Wilkes's Essay; Comm. vol. iii. p. 320; Derbyshire Report, vol. iii. p. 44. In general, however, 4 cwt. of cheese, is considered to be a fair produce. The strongest grazing lands do not produce cheese of the best quality.

312 The economy of procuring hay from meadow grounds, recruited by top-dressings, is doubtful; and this valuable article, had better, in most instances, (in nineteen out of twenty), be raised from lands, usually under tillage, and yielding our ordinary arable crops, in some regular order.—*Coventry's Discourses,* p. 100.

313 Berwickshire Report, p. 136.—The loss is less material, when the dung is spread on the grass land *in October,* just before the expected fall of rain sufficient to wash it into the soil.—*Remark by John Middleton, Esq.*

314 See the opinions of Mr Rennie of Phantassie, and Mr Brown of Markle.—*Husbandry of Scotland,* vol. ii. p. 35, 37.

315 Young's Essay, Comm. vol. iii. p. 140.

316 Many respectable farmers, however, are partial to the top-dressing of meadows, and of pastures, with dung, and where it can be accomplished, without robbing the arable land, but from towns in the neighbourhood, the objections to it may be got over by judicious management. Mr Middleton recommends for that purpose, that the dung should be spread on the grass land *in October,* just before the expected falls of rain, which generally occur at that season of the year, and which will wash the dung into the soil. The loss would not then be material, and might be totally avoided, if composts were made use of.

317 Derbyshire Report, vol. ii. p. 39, and 175.

318 That important subject is fully explained in Mr George Sinclair's paper on Grass Lands, Addenda.

319 Dr Cartwright's Essay; Communications to the Board of Agriculture, vol. iii. p. 131.

320 It is remarked, that in Norfolk, where the land is commonly light, and where sheep are both *bred* and *fed* upon the same farm, a proportion of permanent pasture is essential. Much injury in particular has been sustained, by breaking up permanent pastures, on such soils, more especially when subject to rectorial tithes. Many lands of an inferior soil, which kept two sheep on an acre, paying only vicarial tithes, and rented at ten shillings per acre, since they have been broken up, cannot pay, even without rent, the tithe of corn, and the expense of cultivation. A farm in general lets best, with a fair proportion of grass land upon it, which admits of a mixed management, in consequence of which, if one object fail, another may be successful.—Communication from Mr Blaikie of Holkham.

321 Young's Calendar, p. 87.

322 In the northern counties of England, it is usual to cart the dung on their pasture land, in time of frost, that they may not injure the sward, and because

they have more leisure at that period of the year. This practice is justly reprobated by the intelligent Dr Fenwick. While the frost lasts, the land can derive no advantage from the manure, and when a thaw supervenes, it is evident that the wash from melting snow, or from the rains which generally fall in such weather, must deprive the mass of every part that is soluble: the ground, in the mean time, retains the frost for many days, and is therefore incapable of absorbing the wet, which falls upon its surface; and even when the influence of the milder air has reached it, can imbibe but little, being in general previously filled with water, and the quantity which flows over it, being too great for the soil, under any circumstances, to drink up.—*Dr Fenwick's Essays*, p. 23.

323 See Greenall's Observations on Composts; Comm. vol. iii. p. 290; also Derbyshire Report, vol. ii. p. 184.

324 Those who apply putrescent manures, with the best effect, prefer moderately moist and warm weather, that the dung may be quickly covered. *Derbyshire Report*, vol. ii. p. 185.

325 Chap. III. Sect. 7.

326 Young's Calendar, p. 221.

327 Derbyshire Report, vol. ii. p. 196.

328 Communication from John Middleton, Esq.

329 Lincoln Report, p. 222. Any patches of coarse grass may be removed by the scythe.

330 Communication from Mr Holdich.

331 Essay by Charles Goring, Esq.; Communications to the Board, vol. iii. p. 191.—This rule ought probably to be adopted with respect to the pastures of Rutlandshire, let to cottagers for keeping their cows, see Chap. II. Sect. 5, p. 86.

332 Communication from Edward Burroughs, Esq.

333 See the evidence of this fact, on the authority of Mr Brown of Markle and Mr Hume of East-Barns. Husbandry of Scotland, vol. ii. p. 13; also Young's Calendar, p. 337. This is confirmed by the experience of Mr John Webb. *Derbyshire Report*, vol. ii. p. 138.

334 Derbyshire Report, vol. ii. p. 494.

335 Middlesex Report, p. 219.

336 This plan has been tried in Norfolk, with very great success. Meadows have there been done over with sand, by which the quantity and the quality of the grass were greatly improved; whereas a portion of the same meadow, left in its former state, was quite worthless.

337 In Derbyshire, as a protection of stock from inundations, it is not uncommon to raise mounds of earth in each meadow, two or three yards high, for the cattle to retire to, in case of a sudden flood. *Report*, vol. ii. p. 176; they are called "*safety-mounds*."

338 Middlesex Report, p. 224.

339 Hay is not usually sweated, nor allowed to heat in Scotland; and when hay happens to fall into that state, it is frequently used as litter, or in packing stone-ware, &c.

340 General Report of Scotland, vol. iii. p. 13.

341 Inverness Report, p. 193.

342 Statistical Account of Scotland, vol. vi. p. 248.—Parish of Kintail.

343 Suffolk Report, p. 215. Young's Calendar, p. 208. Derbyshire Report, vol. ii. p. 183.

344 South Wales Report, vol. i. p. 545. It is said that, by this practice, the stock are kept in good condition, and expense is saved.

345 It was invented by Mr Whitworth of Acre House, Lincolnshire. Mr John Bloomfield of Warham, a tenant of Mr Coke's, has the credit of having first carried this novel practice, to any considerable extent. It is fully described in the Hortus Gramineus Woburnensis. Appendix, No. I. p. 415.

346 The grass of orchards would probably be well calculated for the purpose.

347 See Mr Blaikie's valuable tract, on the Conversion of Arable Land into

Pasture, where the whole process is fully detailed. The tract likewise contains several useful hints on other rural subjects.

348 Remark by John Middleton, Esq.

349 Mr Mason of Chilton, an eminent farmer in the county of Durham, entertains an idea, that clover has a tendency to promote mildew or rust in wheat. A field that had been partly oats, and partly clover, was sown with wheat: the crop was mildewed where the clover had been, but not where the oats had been grown. This is an additional circumstance, favourable to the idea, that land, for a crop of wheat, ought not to be in too rich a state. A farmer in the West of England, lately complained, that his rich crops were always mildewed, while his neighbours, whose land was full of couch, and out of condition, did not suffer from that malady. Hence it has grown into a maxim, "That the worst managers, get the best crops, once in seven years." In future, however, that slur on good culture may be prevented, by the diligent farmer, paying proper attention to the diseases of grain and the means of preventing them.

350 Brown's Treatise on Rural Affairs, vol. ii. p. 157. The principal objections to rye-grass are, that it not only exhausts the soil, if suffered to seed, but makes the land too dry and solid.

351 The quantity of clover-seed sown, is from 10 to 12 lbs. per statute acre, on dry friable soils; and from 14 to 18 lbs. on strong loams or clays, with one peck of perennial rye-grass.—*Northumberland Report*, p. 112.

352 In America they likewise apply Indian corn, millet and buck-wheat, to the purposes of soiling.

353 In "*The American Farmer*," vol. ii. Nos. 23 and 24, there are some valuable remarks on soiling, communicated by the Hon. Josiah Quincy, which do great credit to that gentleman's knowledge of agriculture, and from which I have extracted several useful hints in the discussion of that subject.

354 It is singular, that an experiment was reported to the Board of Agriculture, of 33 head of cattle being soiled from the 20th of May to the 1st of October 1815, on 17½ statute acres, in which it is stated, that it would have required 50 acres to have pastured them. The result of Mr Quincy's experiment was nearly the same; for he kept the same amount of stock, by soiling them on 17 acres of land, which had always previously required 50 acres. It is a curious coincidence.

355 Curwen's Report, p. 80.

356 Young's Calendar, p. 374. This doctrine is controverted by other agriculturists. The value of dung depends more upon the nature and quality of the food, than any other circumstance.

357 Curwen's Report, p. 81.

358 The authorities for this important fact, are stated in a note to Sect. 4.

259 Curwen's Report, p. 82.

360 In Flanders, they only sow *six pounds* of clover-seed to the English acre, *for a full soiling crop;* and the cost of the seed at market, is only sixpence per pound. What an encouragement to cultivate a crop, which constitutes the groundwork of all good farming! It is the cost of the seed, which deters the common farmer from having clover, and yet that seed is taxed on importation.—*Radcliff's Report of the Agriculture of Flanders*, p. 61.

361 In dry climates, the practice varies: where the plant is not in a moist state, there is less risk of tedding it. In a good season, it may thus be got thoroughly dry in three or four days. It may be stacked without danger of over heating, on the fourth day; and will come out of the stack in perfect order.—*Communication from Mr Holdich.* For the superior mode of making hay in Middlesex, see Appendix, No. VII, p. 31.

362 It was introduced from Lancashire, into Scotland, and mentioned in the first edition of the Husbandry of Scotland, printed anno 1812. It was likewise tried by Mr Curwen, with the greatest success.—*Report*, p. 42.

363 Young's Calendar, p. 345.

364 Derbyshire Report, vol. ii. p. 180. 365 Ditto, vol. i. p. 182.

366 North Riding Report, p. 177. Perhaps it would prevent firing entirely.

367 The most proper and effectual tethers are made of iron chains, the links short, and two swivels to each chain, to prevent them from twisting. Those for cattle should be five yards long, with a strong leather strap and buckle, to fasten to the fore leg of the animal, near the hoof: those for sheep, may be much lighter, and only three yards long, with belts to fasten round the neck. The tether is secured by a large iron pin, on the head of which, is a large swivel, which should play round the pin freely, otherwise the chain is apt to get entangled.—*Communication from Edward Burroughs, Esq.*

368 Observations by Dr James Anderson. See *Dr Skene Keith's Report of Aberdeenshire*, p. 357, &c.

369 Lord De Vesci has had beef of better quality, and fed in a shorter time, by this system, than by any other he ever tried; and he is now improving some inferior land, on the principle of tethering.

370 This practice is recommended as fit to be adopted in the following cases: 1. When grass-lands are not fenced off from the adjoining fields in tillage; 2. When there are young plantations in the neighbourhood of grass-lands, which cannot, without great expense, be secured from trespass; 3. When extensive fields are to be partly grazed; which cannot be so conveniently divided, so as to separate the grazing, from the arable land; and, 4. When the grass is too short to be cut.

371 Communication from Edward Burroughs, Esq. Mr Burroughs tethered seven sheep per acre in spring; and finding that there was better grass in the field in the middle of May, than when they were first turned on it, he was obliged to put two sheep more per acre to keep down the grass, in a state fit for that species of stock. In the Highlands of Scotland, they contend, that sheep, when tethered, fatten more rapidly than in any other manner.

372 Agricultural Report of Aberdeenshire, by the Rev. Dr Skene Keith, p. 356.

373 Sometimes strong nets are made use of; but hurdles are preferable, unless the sheep are very tame.

374 See Essays on Practical Husbandry, by Edward Burroughs, Esq. (a recent valuable publication), p. 7.

375 Communications to the Board of Agriculture, vol. iii. p. 10.

376 Cruds Economie de l'Agriculture, (a celebrated Swiss author), in 1 vol. 4to, printed at Paris, an. 1820, p. 311.

377 Young's Calendar, p. 106.

378 Annals of Agriculture, vol. ii. p. 359.

379 Young's Calendar, p. 198, 255.

380 Report of the Norman Islands, p. 113.—On the recommendation of the British Board of Agriculture, lucern has been introduced into our East Indian possessions; and potatoes are now more extensively cultivated there than formerly. Both are likely to prove most valuable productions in those countries.

381 There is every reason to believe, that the common, or old rye-grass, is inferior to the new varieties.

382 Cock's-foot is cultivated to a great extent, and with *astonishing success*, at Holkham. The quantity of sheep kept upon it, summer and winter, is *quite surprising;* and the land becomes *renovated*, by laying two or three years under grass, and enriched by the manure derived from the sheep.—*Communication from Mr Blaikie, at Holkham.*

383 Curwen's Report, p. 42.—Cock's-foot does not suit low land, as in such situations, it is apt to grow too coarse. Mr Falla strongly recommends the *festuca pratensis.*

384 Sir H. Davy's Lectures, p. 315, and the Appendix, containing the result of the experiments instituted by the Duke of Bedford. See also the Memoir, in folio, printed by Mr George Sinclair, gardener to the Duke of Bedford.

385 Mr George Sinclair states it as the result of his experiments, that no grass is so well suited for all purposes as *cock's-foot*. A new variety of the *lolium perenne*, (rye-grass), has been lately offered to the experimental farmer, by

Mr Holdich, under the name of "*Russell-Grass,*" of which considerable expectations are formed.

386 Communications to the Board of Agriculture, vol. iv. p. 203, and 210.

387 Communications to the Board of Agriculture, vol. iv. p. 210.—Mr Curwen thus estimates the profit derivable from milch cattle. On an average, each cow, of a good breed, and properly fed, will produce 3739 quarts per annum, which at 2d. per quart, is L.30 : 3 : 2 per cow. The feeding may cost 10d. per day, or L. 15 : 4 : 2 per annum. The interest of capital, risk, insurance, may be stated at L.3. Hence the clear profit from the cow alone, is above L.12 per annum, exclusive of the calf. Allowance is made, in this estimate, for the losses which must unavoidably happen.

388 Communications to the Board of Agriculture, vol. iii. p. 138.

389 This observation is made by Mr Wright, of Ranby, near Retford.—*Comm.* vol. iii. p. 505. The crop of clover, however, often fails, not from deficiency of seed, but from defective cultivation, and want of management. The seeds should always be bush-harrowed, and rolled after being sown, according to the nature of the soil, and other circumstances.

390 Davis of Longleat's Essay; Communications to the Board of Agriculture, vol. iii. p. 95.

391 Marshall's Gloucestershire, vol. i. p. 81.

392 The convertible system of husbandry is much approved of in Northumberland. In light soils the rotation is, 1. Turnips, drilled. 2. Barley, or wheat, drilled. 3. Clover and grass seeds, pastured, at first, partly with cattle, but principally with sheep, but afterwards pastured by sheep alone, for three or more years; then oats. On strong land, the same plan is pursued, substituting fallow or beans, instead of the turnip crop. Under this system, the land never refuses to produce abundant crops of all these several articles.

393 Brown's Treatise on Rural Affairs, vol. ii. p. 197.—Doctor Coventry supports these doctrines in the following terms: The keeping of ground for too long a period, in a state of ley, or under grass, is an error arising from a predilection for grass-land, particularly if inclosed. In many parts of the country, this has given rise to a singular combination of profusion and remissness in the treatment of lands lying adjacent, and in every respect equally well adapted for regular and proper culture.—*Coventry's Discourses,* p. 16.

394 It appears, from the most careful researches, that potatoes will produce, on an average, per statute acre, from 10 to 13 ton weight of food, fit for the human species. Wheat, after deducting seed, will produce, about 21½ bushels per acre, or 1240 lbs. in weight. Whereas, the quantity of animal food produced on an acre, when grazed, will only be about 180 lbs., and even under the dairy system, which is more productive, will rarely exceed 240 lbs.—See *Communications to the Board of Agriculture,* vol. vii. p. 47.—The same weight of animal food, however, goes farther, than of vegetable, and it is raised at less expense.

395 Brown's Treatise on Rural Affairs, vol. ii. p. 200. In England, unfortunately, the alternate system of husbandry, cannot be generally adopted, until the property of the landlord, is more distinctly protected from injury, either by an act of the legislature, or the decisions of the courts of law, enforcing covenants.

396 The lower orders of the Irish, who are a strong and handsome race of people, live almost entirely upon potatoes, with the addition of buttermilk. The ancient Romans lived much upon turnips.

397 This is done by tying them up, by which their colour is improved;—any acrimonious bitterness in the plant is prevented;—and they are rendered more tender for eating.

398 Perhaps the proper *boiling* pea may be an exception.

399 Middlesex Report, p. 265.

400 It is incredible how much the middling and lower orders live upon vegetables in the summer and autumn. In these seasons, it is supposed that the gardens feed more people than the fields.—*Lysons' Environs of London,* vol. i. p. 28.

401 The reduction is from one-third to two-fifths of the value of the average produce, with little diminution of the running and unavoidable expenses.

402 Middlesex Report, p. 267. The profits of the dealers are not included in this calculation.

403 Mr Neill's Chapter on Gardens, General Report of Scotland, vol. ii. p. 85. The produce is about L.45 per Scotch acre. Even strawberries do not yield more than from L.40 to L.50.—*Ditto*, p. 90.

404 An experiment was tried, what quantity of onions could be produced by dint of manure; and on a quarter of an acre, three tons, gross weight, were raised, which sold for L.24, and left a profit of L.13 after paying the expenses, which amounted to L.11. The seed was originally from the white Lisbon onion, naturalized to the soil.—*Communication from the Rev. Robert Hoblyn.*

405 Aberdeenshire Report, p. 364.

406 This depends much upon the soil. Mr Middleton observes, that the best soil for a fruit-garden, is a free marl (malm). This soil prevails at Brentford and Isleworth, in Middlesex, and advantage has been taken of that circumstance, to build numerous walls, ten feet high, from the produce of which the fruit shops in London are supplied with the very best apricots, peaches, nectarines, and pears.—*Communication from John Middleton, Esq.*

407 It is calculated, that for the protection of exotic fruits, 479,360 square feet of glass are employed in Scotland alone.—*General Report of Scotland*, vol. ii. p. 121.

408 General Report of Scotland, vol. ii. p. 131, and Appendix, vol. iv. p. 452, where there are some additional hints for improvements of a more minute description.

409 Mr Middleton states, that some of the fruit-growers of Brentford, Middlesex, protect the blossoms and fruit till out of danger, by a deal or other board, ten or twelve inches in width, placed horizontally upon brackets, near the top of their fruit-walls; and these are said to afford considerable security to their fruits, (which are supposed to be the finest in Britain), against frost, &c. —*Communication from John Middleton, Esq.*

410 See White's Canada, p. 128.

411 " If the trees have their bark base, you must, with a bill, *take away the* " *old bark to the quick;* for the trees being thus discharged, do shoot forth with " new strength," &c. Le Gendre, Curate of Hunonville, translated and printed at London, an. 1666, a small octavo volume, p. 136. In Hitt's Treatise on Fruit-Trees, printed an. 1756, 8vo, p. 122, it is said, " For those trees that are " not dressed at all, *taking off the old rind,* and cleansing the cankered parts, de- " stroys many insects and their eggs."—In Rivington's Annual Register for 1726, title " Useful Projects," p. 109, we are told, that it is customary in Connecticut, to strip off the bark of old decayed apple-trees, taking care not to injure the inner bark, to renovate the trees. In M'Phail's Gardener's Remembrancer, p. 28 and 29, notice is taken, of experiments made at Kensington Gardens, an. 1802, of peeling or cutting off the *outer bark,* without damaging the *inner bark.* Also in p. 119, the peeling off the loose bark of the vine, and washing the plant with water and soap, with a sponge, is recommended.

412 The late Mr P. Lyon of Comely Garden, near Edinburgh, tried the experiment on above 800 fruit trees, both young and old, and with considerable success. T. A. Knight, Esq. recommends, in the case of old trees, after taking off the old bark, to graft, on the old stump, new varieties. This hint may be of the greatest service in decayed orchards.

413 Lancashire Report, p. 83; Derbyshire Report, vol. ii. p. 215.—In May 1808, Mr Shephard's bailiff cut out a ring of bark, between too and three inches broad, and the full depth of the bark, from a very old pear tree, that had never borne fruit, and the consequence was an abundant crop.—*Buckinghamshire Report,* p. 252.

414 Bedfordshire Report, p. 156.

415 It is much disputed, whether rich and putrid dung is of use to vegetables. Some contend, that all vegetable produce is sweeter, and more delicate

in proportion to the quickness of its growth, and that none have so ill a flavour, as those on poor soils, ill manured, that will not advance them sufficiently quick. It is the quick-formed juice that is the sweetest: and thence, it is contended, that the rankest and most putrescent manures, give the finest taste, because they make the plants shoot away with the greatest celerity.—*Young's Annals of Agriculture*, vol. xxxix. p. 303. These doctrines are supported, by the high repute in which the unusually large and luxuriant vegetables are held, which are grown at Mr John Gratian's garden at Belper, by the aid of liquid night-soil, and sewer-water, applied in the way of irrigation.—*Derbyshire Report*, vol. ii. p. 209. On the other hand, it is maintained, that vegetables raised by abundant fetid manure, can never be so well tasted, nor so wholesome; —that London brocoli, for instance, has a strong, and most disgusting flavour; —and that a turnip from a common tillage field, is much superior to what can be obtained from a rich garden. On the whole, it would appear, that when a large portion of dung is used, the vegetable is forced so rapidly, that it is insipid, or deficient in flavour,—that a moderate quantity of dung, produces plants of a better quality,—but that vegetables, grown luxuriantly in a fresh maiden earth, are the sweetest. In such soils, the leaves of the brassica, or cabbage tribe, are sometimes so superior in quality, as to be nearly transparent.

416 General Report of Scotland, vol. ii. p. 94. When sea-weed could be had at Kirkcaldy, at a reasonable rate, the crops of onions were remarkable for their produce. Sometimes from eight to twelve pecks were got per fall, and sold for 4s. per peck.—*Ditto.* Onions thrive well when transplanted.—*Derbyshire Report*, vol. ii. p. 212.

417 Soapers' waste is found to check, and to destroy the club or *bodge*, so destructive to the growth of the *brassica*, or cabbage tribe. This disease is occasioned by a maggot perforating, and depositing itself, in the stem part of the root, by which the juices, intended for the growth of the upper part, are prevented from ascending, and are converted into a hard substance beneath the surface, which sometimes weighs a pound or more. Soapers' waste might prevent a disease of a similar nature, to which turnips are liable.

418 Vanderstraeten's Improved Husbandry, p. 162.

419 See this subject very ably treated of in the Chapter on Gardens, by Mr P. Neill; General Report of Scotland, vol. ii. p. 105.

420 Middlesex Report, p. 330.

421 The expense of glass used in artificial gardening, to force an earlier production, is very considerable. They are of two sorts, hand-glasses and globe-glasses. The former cost 5s. each, the latter 8s. But these are not now to be purchased, except at sales, even at that price. If bought new, they would cost from 10s. to 12s. each, in proportion to their weight, according to which the duty is levied.

422 From 200 to 300 acres of celery may be annually grown in the neighbourhood of the metropolis, to be consumed as a salad, to flavour soups, &c. Celery is considered to be a powerful antiscorbutic.

423 General Report of Scotland, vol. ii. p. 90.

424 Near Devizes, and other towns in Wiltshire, many families subsist by occupying from two to five acres each, as garden ground. The soil is sandy, and applied to the produce of esculent vegetables, for the consumption of the neighbouring towns and villages.—*Wilts Report*, p. 82. So productive are gardens, when well managed, that three brothers, who followed the art of gardening, supported as many families, very decently, and gradually acquired some wealth, by the cultivation of about five acres of land.—*Berks Report*, p. 301.

425 The Rev. Mr Hoblyn thinks, that gardens in the country, are more advantageously cultivated *by the plough* than the spade, for as much work is done in a day by the one power, as in a month by the other. In his own garden, the first ploughing is carried to the depth of nine inches, the second in the same furrow to six more, the whole depth fifteen inches. Having a command of space, the ground was only cropped once a year, and by this means it was kept clean and in good condition.

426 Trench ploughing, for garden farming, costs from 30s. to 50s. per acre; whereas digging and trenching with the spade costs from 50s. to L. 4 per acre; and deep trenching with the spade, from L. 4 to L. 6, and, in some cases, even L. 8 per acre.

427 General Report of Scotland, vol. ii. p. 74; Gloucestershire Report, p. 196; Berks Report, p. 305.

428 Berks Report, p. 305.

429 On the subject of farmers' gardens, more especially cultivated by the plough, some valuable hints will be found in the Annals of Agriculture, vol. xxxix. p. 228, and 304.

430 Bedfordshire Report, p. 458.

431 The best white wine is made from the large Dutch white currant, but the sugar must not be of inferior quality. From the black currant, an excellent liquor is manufactured, which is called *gazle wine* in Kent. See the recipe in Marshall's Southern Districts, vol. i. p. 318.

432 A carpenter at Steyning, plants about 20 rods of his garden with what is called "*the under ground onion*," and potatoe sprouts, and sells annually 20 bushels of onions at 10s. per bushel, and 30 bushels of potatoes at 2s. or L. 13 in all. As there are 160 rods in an acre, the above is a large return. He also raises radishes and celery on the same ground.—*Communication from Mr Bannister of Steyning.* The ground onions are sown in March, as potatoes, and earthed up like them. The principal advantage derived from cultivating them is, their being earlier than the common onion, unless the latter are sown in autumn, and transplanted in the spring, which is often done in the neighbourhood of London, with the aid of glasses.

433 General Report of Scotland, vol. ii. p. 65.

434 Ibid. vol. iv. p. 422.

435 Essex Report, vol. ii. p. 131.

436 Communication from John Middleton, Esq. It is said that some land is let, near Hoxton, to some London citizens who amuse themselves with gardening, at the rate of L. 5 for a plot of ground containing only two hundred square yards, which is the highest rented land, *for cultivation*, known in the kingdom.

437 General Report of Scotland, vol. ii. p. 89.

438 Bedfordshire Report, p. 457.—The soil at Sandy is so favourable to vegetables, that cucumbers and onions are sown broad-cast, in the open fields. The produce is partly sent to the London markets.

439 General Report of Scotland, vol. ii. p. 93.—The acre mentioned in this chapter of the General Report of Scotland is the Scotch one, which is one-fifth more than the English. A proportional deduction from the rents therein specified has been made, to make the rent applicable to the English or statute acre.

440 In regard to farmers, also, they cannot be too attentive to the quality of the seeds they sow, and they should not only select their clover and other seeds from the stock or sample, but they should see those seeds weighed or measured, and, to prevent imposition, should see the seeds delivered to the person who is to have the charge of them. It is by attention to these minutiæ that the active and industrious farmer is distinguished.

441 The objects of the latter institution are declared to be, "The promoting and improving the cultivation and improvement of the best kinds of fruit,—of the choicest flowers,—and of the vegetables which are most useful in the kitchen." The display of fruits, flowers, and vegetables, at some of the meetings, has been such, as to draw forth the admiration of the most experienced amateurs, and of the best practical judges. Upwards of 200 prize medals have been distributed by the Society since its institution; and a number of valuable papers have been published in its Memoirs.

442 With a view of exciting emulation, it is a good plan to have annual shews of fruits or vegetables, for the purpose of directing the attention of gardeners to the best varieties of the different sorts. In Manchester they have celery

shows, and in other parts of Lancashire, those for gooseberries, &c. See Derbyshire Report, vol. ii. p. 213.

443 It may be proper here to mention a curious fact recorded in the Survey of the Hebrides. A cottager there, had his cabbages much injured by the caterpillar. He surrounded his little garden *with hemp*, and was no more molested by them, the smell of that plant being noxious to insects. The same idea exists in France, as appears from the following paragraph: " Quelques personnes ont cru reconnaître qu'on semant du chanvre sur toutes les bordures d'un terrain, les chenilles n'ont point dépassé cette barrière, quoiqu'elles infestassent tout le voisinage."

444 It is probable also, that much useful information might be obtained from China, regarding fruit trees and gardening.

445 The information he obtained in Flanders was peculiarly valuable. Much might be expected in a country, where, it is said, that no species of fruit trees that the country was ever possessed of has become extinct.—*Vanderstraeten's Improved Agriculture*, p. 160, note.

446 General Report of Scotland, vol. ii. p. 182.

447 Marshall's West of England, vol. i. p. 233.

448 Berks Report, p. 475.

449 This will in a great measure depend on the peculiar fitness or otherwise of the soil and situation of the spot selected, for apple culture. Mr William Smith, in carrying on the investigations for his large Map of the Strata of England, &c. discovered, among some other things relating to vegetable products, that all the chief cider districts, and the sites of all the best apple orchards, were on the same stratum of *red marl*, which stretches across the island from Dorsetshire to Yorkshire. Wherever it appears, the soil is fitted, by nature, to the purposes of orcharding, in a peculiar degree, perhaps more so than any other in our island.—*Comm. from Mr Farey*. On which Mr Middleton observes, that valuable fruit, hops, and corn, are raised, with peculiar success, on calcareous soils.

450 Gloucester Report, p. 238.

451 Marshall's West of England, vol. i. p. 233.—Inferior grass lands are often much benefited by being planted with fruit-trees. As orchards, the shelter of the trees, and the dropping of the leaves in autumn, promote their fertility. They should not, however, be planted too close, as the trees would soon become mossy, and decay; and the grass, from being too much sheltered, would become sour and unkind: both objects would thus be defeated.—*Remark by Edward Burroughs, Esq.*

452 Herefordshire Report, p. 91.

453 Marshall's Gloucestershire, vol. ii. p. 295. In regard to the idleness and debauchery which cider orchards are alleged to occasion, it is justly observed in the Somerset Report, p. 126, " That we ought not to confound the abuse of a thing, with its intrinsic value."

454 A Treatise on the Culture of the Apple and the Pear, by T. A. Knight, Esq. p. 44, note. That, however, is of less consequence, as an acre of pear trees, the fruit converted into perry, is found to equal what many persons in France, derive from good vineyards.

455 Herts Report, p. 443.

456 Marshall's Southern Districts, vol. i. p. 305.

457 Oxfordshire Report, p. 220. The high value of walnut tree wood, as well as the profit derived from the fruit, seems to require a more extensive planting of them. See Derbyshire Report, vol. ii. p. 215.

458 Marshall's Southern Districts, vol. i. p. 307.

459 General Report of Scotland, vol. ii. p. 180.

460 Devonshire Report, p. 239.

461 Somerset Report, p. 220.

462 Marshall's Gloucestershire, vol. ii. p. 271.

463 Somerset Report, p. 124.

464 Herts Report, p. 143.

465 General Report of Scotland, vol. ii. p. 166.
466 Ditto, p. 181.
467 Berks Report, p. 306.
468 Devon Report, p. 244.
469 Marshall's Gloucestershire, vol. ii. p. 392.
470 Herefordshire Report, p. 90.
471 Berks Report, p. 364.
472 Communication from the Rev. Robert Hoblyn.
473 General Report of Scotland, vol. ii. p. 186.
474 Marshall's Gloucestershire, vol. ii. p. 286. 475 Ibid.
476 Herefordshire Report, p. 91.
477 Middlesex Report, p. 324.
478 General Report of Scotland, vol. ii. p. 180.

479 This plan was strongly recommended by the late S. Dyot Bucknall, Esq. If hops are cultivated by the spade, they can do no injury to the roots of the trees, if judiciously worked, while the loosening of the earth, to a good depth, and the liberal expenditure of manure, tends evidently to the benefit of the plants, as well as to the ensuring rich pasture, whenever the size of the trees is such, as to be prejudicial to the further cultivation of hops. It is evident, however, that this practice can only be applied to congenial soils.—*Communication from Sir Charles M. Burrell,* Bart. M. P.

480 Marshall's Southern Districts, vol. i. p. 319.
481 Marshall's West of England, vol. i. p. 225.
482 Report of the Norman Islands, p. 125.
483 Essex Report, vol. ii. p. 132.
484 Marshall's Southern Districts, vol. i. p. 312.
485 Marshall's Gloucestershire, vol. ii. p. 322, note.
486 General Report of Scotland, vol. ii. p. 185.

487 Herts Report, p. 143. Tethering stock in orchards, is a better plan than mowing, or allowing the stock to pasture at large.

488 Herts Report, p. 143.
489 Bedfordshire Report, p. 312.
490 Surrey Report, p. 422.

491 Communication from Sir C. M. Burrell, Bart. M. P.—*Fish-oil* is preferable to linseed-oil, on account of its stench, which is highly injurious to insects. Olive-oil is also injurious to them, and promotes the health of the trees. It is said, that to have water applied with a hand-brush, would answer, and it is a cheap application. The following liquid is the most effectual of any;—Take two ounces of quicksilver, and the same quantity of salt. These two substances to be mixed together, so as to kill the quicksilver, by stirring them about with a stick six or seven inches long. The hand not to touch the mixture on any account. When the two substances are well incorporated together, (which is generally in about five minutes), add one gill of rape-oil, and two tea-spoonfuls of spirit of turpentine.—Stir them till fit for use. The liquid to be applied with a feather, and it will be found an infallible means of destroying every species of vermin, in houses, hot-houses, gardens, or orchards.

492 Communication from Sir C. M. Burrell, Bart. M. P.

493 In a paper drawn up by the Right Hon. William Adam, (General Report of Scotland, Appendix, vol. iv. p. 472), the advantages of shelter, are ably explained; as well as several other important particulars connected with the success of plantations. See also Kent's Norfolk, p. 92.

494 They are detailed in the Chapter on Woods and Plantations, in the General Report of Scotland, Chap. X. vol. ii. p. 197; and in Marshall, on Planting and Rural Ornament, vol. i. p. 47. The advantages furnished by trees to the feeding of stock, are not much attended to in this country, though in others, as in Italy and Sweden, trees are considered a great resource. The leaves of the elm, the maple, and the poplar, are preferred in Italy; but those of the oak and the ash are also used, particularly mixed with others. They are gathered about the end of September or beginning of October, and after

being spread on a pavement to dry, for three or four hours, they are put in wooden casks, or in pits covered first with straw, and then with clay or earth. There is no dry food on which cattle and sheep thrive better, than on leaves well preserved. *Professor Symonds' Communication, Annals of Agriculture,* vol. i. p. 207.—The sheep of Sweden, who are kept seven months in the house, have one meal every day, of the leaves of the birch, the willow, &c. *Communications to the Board of Agriculture,* vol. i. p. 313.—The late Sir Cevil Wray found, that the boughs of the Scotch fir, given to sheep in snow, saved much hay, and kept deer perfectly well in winter.—*Lincolnshire Report,* p. 216.

495 Kent Report, p. 146.

496 Sussex Report, p. 184, 185.

497 West Riding Report, p. 129.

498 Staffordshire Report, p. 99.—In Flanders, barren lands have been planted in general with the Scotch fir, principally with a view of supplying them with the materials of future cultivation. It has been found, that in thirty-five years, an arable soil of from five to six inches thick, is formed from the decayed leaves. If the trees are then cut down, and young ones planted, (for young trees produce the greatest quantity of leaves), the vegetable mould will become a foot in depth, and may then be cultivated in perpetual rotation, with all the various crops raised in the neighbourhood. This is certainly a tedious mode, but there is a profit from the trees in the interim, joined to the prospect of future improvement.

499 General Report of Scotland, vol. ii. p. 249.

500 Herts Report, p. 145.

501 Kent Report, p. 145.—This is about L.10 per acre per annum, from which deduct taxes and other burdens, and it stills remains very profitable.

502 Kent Report, p. 146.

503 In many cases, the successful growth of forest trees, depends more on the underground, than on the soil itself. The latter is principally of use in the early stages of the growth, but ultimate perfection entirely depends on the nature of the subsoil, its depth, soundness and moisture. Poor sandy soils in Norfolk, not fit for corn, and producing nothing but bent grass, will yield thriving timber, if the subsoils are loamy. In some parts of France, soils incapable of producing crops of corn, are clothed with luxuriant timber.—See Young's Travels in France.

504 Staffordshire Report, p. 98.

505 Somerset Report, p. 129.

506 Somerset Report, p. 229.—But when cut only once in 20 years, it reduces the real annual produce to half the nominal produce, or from 20s. to 10s., and this subject to taxes and other deductions, which would diminish the real to about one-third of the nominal produce.

507 Somerset Report, p. 233.—In a note to p. 234, it is stated, that Mr Parsons, of West Camel, had greatly improved such wet clay soils, by burning all the earth and clay he could find in his ditches, with wood, and reducing them into a pulverized state. He mixed the whole with any manure he could command, and spread it with great advantage, on either arable or pasture land.

508 Marshall's Review of the Northern Department, p. 224, 225.

509 Derbyshire Report, vol. ii. p. 224, and 225.

510 Wilts Report, p. 86.

511 Somerset Report, p. 128.

512 If compound interest were allowed, as it ought to be, the comparison would be much in favour of cultivation. Deduct taxes and other burdens, and from 17s. it would be reduced to 10s., and when the profits of a tenant are considered, it is supposed that a rent of 10s. is as much as could be obtained. —*Remark by John Middleton, Esq.*

513 Lincoln Report, p. 217. Marshall's Review of the Eastern Department, p. 12.

514 West Riding Report, p. 128. This is about 31s. per acre, which is equal to about 20s. clear of taxes. Mr Surties, of Newbigging, obtains up-

wards of L.100 per annum from 60 acres of woodland. *Northumberland Report*, p. 125.—In Cornwall, copse wood of common oak, cut down at from 20 to 30 years' growth, sells at from L.20 to L.60 per acre. *Cornwall Report*, p. 98.—The tithe laws of England, in many cases, render it more profitable to raise wood than grain, in many descriptions of soil.

515 This is about 27s. per acre per annum, or 20s. per acre, deducting taxes, &c.

516 Report, vol. ii. p. 224. The reporter is a strenuous advocate for clearing many of the best woodlands, and bringing them under cultivation. Plantations, he admits, should at the same time be extended, over steep and stony wastes.—*Ditto*, p. 226, 236, and 261.

517 Sussex Report, p. 179.

518 Darwin's Phytologia, p. 526.—L.1 in 15 years, is less than 10s. per annum, after paying taxes, and other deductions. The rent would not exceed 7s. per acre.—*Remark by John Middleton, Esq.*

519 In the Cotswold Hills in Gloucestershire, from the want of wood, they are under the necessity of using straw as fuel, thus destroying the fertility of their arable land. *Turner's Report of Gloucestershire*, p. 54.—In the Staffordshire Report, p. 98, note, their earthenware could not be sent out of the country, unless packed up in *crates* or baskets. Coal mines without wooden props could not, in many cases, be worked.

520 The inhabitants of the Hebrides, for instance, have to undertake a dangerous voyage, of from thirty to seventy miles, before they can build a barn;—or make a plough, even of the rudest construction;—or procure a flail; or even the handle of a spade. This want of timber distresses the people in their houses, in their husbandry, and in every art.—*Dr Walker's Economical History of the Hebrides*, p. 207.

521 Analysis of the views of "Improved Agriculture," &c. by F. Vanderstraeten, (a Flemish author), p. 18. In Britain, proprietors generally receive the value of the soil cultivated, in 25 years, by annual instalments; but in Flanders, the plantations round their fields, will yield, it is said, the value of the cultivated, as well as planted soil, in 40 years.

522 West Riding Report, p. 123.

523 Wilts Report, p. 89. Derbyshire Report, vol. ii. p. 221, 228, 315.

524 Berkshire Report, p. 240.

525 Wilts Report, p. 84.

526 Wilts Report, p. 85.

527 Sussex Report, p. 165.

528 Vancouver's North-East Essex, p. 32. Young's Calendar, p. 33.

529 Derbyshire Report, vol. ii. p. 264.

530 Somerset Report, p. 230.

531 General Report of Scotland, vol. ii. p. 81.

532 Wilts Report, p. 89.

533 Mr Davis, Wilts Report, p. 86, enumerates the various purposes to which young trees are applied, as *Ash poles*, for sheep cribs, rind hoops for barrels, rigging for ships, &c. *Hazel*—Sheep hurdles, spars for thatching, and pease and beans sticks, dead hedges, &c. *Alder, Willow, Birch*, &c.—Poles for rafters, pattens, clogs, shoe-heels, coal pit uses, rails for fencing, &c. *Oak*—For hop-poles, where the culture of that plant prevails, &c.

534 Preliminary Observations to the Westmoreland Report, p. 288.

535 It is still so about Wingerworth, Alderwasley, &c. *Derbyshire Report*, vol. ii. p. 235.

536 Cheshire Report, p. 326. Derbyshire Report, vol. ii. p. 339.—These twigs and buds are collected by women and children, and pressed into bags when dry. They should be used early by the tanners, after being crushed under their rolling stones.

537 Sussex Report, p. 182.

538 Hence it is strongly recommended, as a matter of policy as well as jus-

tice, that higher prices for large timber, should be paid by the public, than heretofore has been usual. *Derbyshire Report*, vol. ii. p. 225, 227, 315.

539 Nine shillings per acre per annum, for 100 years, payable at the termination of that period, is less than a rent of 4d. per acre per annum, payable every year. One shilling per acre per annum, in 100 years, would amount to L.130.

540 Sussex Report, p. 171, 172.

541 Derbyshire Report, vol. ii. p. 226.

542 Ditto, vol. ii. p. 330.

543 Sussex Report, Appendix, No. II. p. 469. It is said that a 74 gun ship requires 3000 loads of wood, the produce of 50 acres, each tree standing about 33 feet apart, which, at L.15 per load, would be L.900 per acre. At one rod apart, the extent required would be twelve acres and a half. *Marshall on Planting*, vol. i. p. 112.—In the Memoirs of the Academy of Brussels, vol. iv. p. 263, there is an essay by M. De Limbourg Le Jeune, on the means of improving timber for the navy, which seems to merit attention. By previously barking the tree, it is said, that the whole timber it produces is thereby rendered equally firm and solid. But this is a point on which there is a difference of opinion. *Derbyshire Report*, vol. ii. p. 331.—The fact ought to be ascertained by accurate experiment. The American white oak is strongly recommended, as superior to every other for the wheels of carriages.

544 Young's Calendar, p. 34.

545 Oxfordshire Report, p. 224.—The north side of a hill, produces a better growth of beech than the south side ; a proof of the hardiness of the plant.

546 Sussex Report, p. 222.

547 Oxfordshire Report, p. 222.

548 Bucks Report, p. 256, note.

549 Inverness Report, p. 212.

550 Buckinghamshire Report, p. 260.

551 Bishop Watson's Preliminary Observations to the Westmoreland Report, p. 290.

552 Marshall's Review of the Northern Department, p. 225, note.

553 Derbyshire Report, vol. ii. p. 330.

554 Wilts Report, p. 91.—The acre, which was measured in the form of 16 perches by 10, was found to contain the following quantities of timber:

	Feet.		*Tons.*	*Feet.*
Nine oaks, measuring - - - -	2952	or	73	32
Twenty chesnuts and abeles, - -	3182		79	22
Twenty-two small trees of various kinds,	280		7	
Total, -	6414	or	160	14

Being fully one ton of timber to a perch of land.

555 In Perthshire, Col. Robertson of Struan has a natural fir wood, that covers 2566 acres. *Report*, p. 235.

556 The natural fir woods of Ross-shire, except one or two on the Balnagowan estate, are mostly exhausted. *Report*, p. 204.

557 It was the trees that exceeded a specific circumference of bole, which were by this contract to be felled. Since that was done, the younger wood has made a great advance. *Moray Report*, p. 291.

558 In the upper parts of Aberdeenshire, the fir timber is of slow growth. It appears, in many cases, to be above 100 years old, and sometimes about 230 years, from the number of concentric circles near the root ; and it is considered far superior to any timber ever imported from Riga, Memel, or any part in Prussia, or Norway. *Aberdeenshire Report*, p. 372.

559 Where the soil is thin and barren, trees should be sown, as the tap-root finds more nourishment from the subsoil ; but if the soil is wet, and pretty deep, it is much better to plant them.—*Shropshire Report*, p. 212, 214.

560 Wilts Report, p. 94.

561 Wilts Report, p. 96. Young plants, digging holes, planting, and protection, may be stated at L. 10 per acre, the interest of which is 10s. per annum. In 100 years, the timber and underwood, if the plantation succeeded, might sell for L. 130. That is not 26s. as is generally supposed; for one shilling per acre per annum would amount to L. 130 at compound interest, in 100 years.

562 Lord De Vesci finds, if the grass cannot be cut for soiling, that it is the best plan to tether the stock in woods and plantations.

563 There are four sorts of larch, but the common white larch *(Larix pyramidalis)* is the best entitled to attention, where it will thrive.

564 Derbyshire Report, vol. ii. p. 252.

565 Observations on the Larch by the Duke of Atholl.—*Communications to the Board of Agriculture*, vol. vii. p. 273.

566 Communications to the Board of Agriculture, from the Duke of Atholl, vol. vii. p. 276.

567 Lambert, in his description of the genus *Pinus*, enumerates ten distinct substances, as turpentine, tar, pitch, lamp-black, &c.

568 The Duke of Atholl sold a larch of 50 years old, for twelve guineas. A fir of the same age is only worth fifteen shillings.—*Communications to the Board of Agriculture*, vol. vii. p. 276.

569 Lincolnshire Report, p. 245.

570 Papers of the Bath and West of England Agricultural Society, vol. x. p. 312.

571 Remark by Edward Burroughs, Esq.

572 There is reason to believe, that all the finer branches of tanning, ought to be done by the bark of the mountain-ash, the birch, or the willow tribes, in preference to the oak. Fishermen greatly prefer having their nets barked first with these materials, and afterwards with oak bark.

573 Mirbel's Lecture, p. 45.

574 Birch wine is made in Derbyshire, with the assistance of coarse sugar and raisins.—*Report*, vol. ii. p. 216, where the process is described. The most advantageous period for collecting the sap, is immediately before the leaves have expanded.

575 This oil would be peculiarly calculated, mixed with butter or grease, for smearing sheep, and a small quantity of it would be sufficient.

576 Davis of Longleat's Essay on Planting; Papers of the Bath Society, vol. x. p. 311.—Mr Davis states, that eight pounds per acre per annum, have been actually made of plantations of this description in the neighbourhood of Highworth, on land not intrinsically worth 10s. per acre for any other purpose. Such respectable authority cannot be questioned, however astonishing the circumstance may appear.

577 Marshall's Norfolk, vol. ii. p. 71. See also Wilts Report, p. 98.—Every farm should have as much ash, and other trees, as will supply it with hurdles.—*Bucks Report*, p. 254.

578 See Appendix to the Second Report of the Select Committee of the House of Commons, on the State of Disease, &c. in Ireland, printed an. 1819, p. 141 and 148. The roots of the ash had not gone down, but had grown quite on the surface, appeared uncovered on the sides, and were coated with a strong bark.—*Ditto.*

579 Cornwall Report, p. 102.

580 Middlesex Report, p. 280.

581 Galloway Report, p. 173.

582 Aberdeenshire Report, p. 377.

583 Dr Walker's Hebrides, p. 261.

584 An isolated fact is mentioned, that a yew tree grew on a sea cliff, in the stormy island of Bernera, one of the Hebrides, which, when cut into logs, filled a large boat. General Report of Scotland, (Appendix), vol. iv. p. 466. The seed was probably brought there by a bird. It would be a most important discovery,

if the fact were ascertained, that yews would grow in such exposed situations, for under their shelter, other trees might be raised.

585 Wilts Report, p. 98.

586 Cornwall Report p. 49.

587 Walker's Hebrides, p. 196, &c.

588 Holt's Lancashire, p. 84 and 85.

589 This tree is the best substitute for the oak, and grows remarkably quick in loamy and clay soils: for ship-building, it is inferior to the oak, but for most uses, it is equal to that tree, and in buildings and out-door work, it is much superior. If it gets old, the timber is apt to get brittle. It should therefore be cut, when the tree is in a growing and healthy state.—*Kent's Norfolk*, p. 94 and 222.

590 Mr Saville of Bocking, in Essex, planted five acres of moory land, fourteen years ago, with ash, and they have thriven so greatly, as to promise to be the most profitable crop on his whole farm.—*Young's Essex*, vol. ii. p. 148.

591 General Report of Scotland, vol. ii. p. 205.

592 Wilts Report, vol. ii. It is said, that an acre of very bad soil, sterile red clay, and peat, in the space of 23 years produced ash trees, to the value of L.115, 10s. being upwards of L.5 per acre per annum.—*South Wales Report*, vol. ii. p. 58.

593 Wilts Report, p. 90.

594 General Report of Scotland, p. 90, 208.

595 Dr Rigby's Report of Holkham, p. 27. The black Italian poplar, when judiciously planted as a screen round barns, and farm-buildings, is said to be the most profitable for planting, of all the poplars.

596 This is attended to in the Netherlands. See also Derbyshire Report, vol. ii. p. 259.

597 General Report of Scotland, vol. ii. p. 277.

598 Somerset Report, p. 127.

599 Galloway Report, p. 182.—On inclosing some commons near Poole, in Dorsetshire, about the year 1805, several hundred acres of miserable land, covered with stunted heath, were sold freehold at five guineas per acre; and contracted to be inclosed and planted with 2500 forest trees, as well as supply the places of dead plants with living ones, and protect the whole for seven years, for other five guineas per acre.—*Communication from John Middleton, Esq.*

600 Communication from Sir Charles M. Burrell, Bart.

601 Too great a partiality for trees, often occasions an error, which defeats the object of the planter and improver. It is as necessary to thin trees judiciously, as to plant them with care and judgment; and yet it too often happens, that those who are *extremely* fond of planting, cannot reconcile it to their taste or judgment, to cut away trees that absolutely *injure* their plantations, and ultimately defeat their progressive improvement. Surely no person can dispute, that a grove, or plantation, consisting of trees well furnished with branches and rich foliage, is not a more pleasing and beautiful object, than a plantation interspersed with half dead and naked stems. Nor is it to be supposed, that trees crowded together, robbing each other of support, and of the invigorating powers of the sun and air, can arrive at a profitable growth. It is more absurd to refrain from cutting away young trees *when necessary*, than it is reprehensible, not to plant when it may be done with advantage.—*Communication from Edward Burroughs, Esq.*

602 Neill's Horticultural Tour, p. 520.

603 A respectable Scotch Judge, (the late Lord Polkemmet), grafted the English on the Scotch elm, and the service-tree on the mountain ash, and found them to answer.—*West Lothian Report*, p. 244. Grafting foreign on English oak, has likewise been successfully tried in England.—*Marshall on Planting*, vol. i. p. 311.

604 Somerset Report, p. 232.—Ten shillings annually for thirty years, would amount to L.33.

605 Galloway Report, p. 182.

606 Clydesdale Report.

607 On this account, it ought to be a favourite object with the apparent inheritors of estates, to turn their attention to the planting, pruning, thinning, and other improvements, of the property they are likely to possess.—*Derbyshire Report*, vol. ii. p. 339.

608 Somerset Report, p. 128.

609 Wilts Report, p. 87.

610 Entitled, " Report of the Committee for Experiments on the Naturali-" zation of useful and ornamental Plants, under the Climate of Scotland," &c. &c.—*Drawn up by John Yule*, M.D. F.R.S.

CHAP. V.

1 See " Some Thoughts on Agriculture, both Ancient and Modern," printed in the works of Dr Samuel Johnston, edit. 1806, by Murphy, vol. ii. p. 440. A modern writer compares agriculture to speech: " Agriculture, (he observes), " is an art which can live without all others, but no other without it. This art " is like speech, without which the society of men cannot be preserved; the " others, like figures and tropes of speech, which serve only to adorn it." Another modern author denominates the productions of the soil, " The fountains " of national wealth and independence; and the source of individual prosperity " and riches."—*Curwen's Report*, p. 1.

2 Holland is commonly adduced as an instance in opposition to this doctrine; but even there, a considerable surplus of butter, cheese, and other agricultural productions, is exported to other countries; and its power and wealth, principally arose from its extensive fisheries, and from its situation at the mouth of great estuaries, and large rivers, with a vast extent of continent behind it, which it supplied with goods. It was thus rendered particularly fit, both for carrying on trade, and for general commerce.

3 Malthus's Inquiry into Rent, p. 10.—An American statesman, has ably described the importance of agriculture in the following words: " The faculty " of cultivating the earth, and of rearing animals, by which food is increased be-" yond the spontaneous supplies of nature, *belongs to man alone.* No other ter-" restial being, has received a higher gift than an instinct, like that of the bea-" ver, or the ant, which merely hoards for future use, the food spontaneously " furnished by nature."—See Mr Maddison's Address to the Agricultural Society of Albemarle, May 12. 1819; printed in The American Farmer, August 20. 1819.

4 The following is the value of the surplus produce per acre in this case:

11 bushels and a peck of grain of various sorts, at 8s.	L.4	10	0
Butchers' meat, ...	0	7	0
Total, ...	L.4	17	0

5 In this case, the value of the surplus produce per acre is:

10 bushels of various sorts of grain at 8s.	L.4	0	0
Butchers' meat, ...	0	10	0
	L.4	10	0

6 Montesquieu observes, " that agriculture, that greatest of all manufactures, " ought to flourish, before what we commonly call manufactures, can properly " be considered as articles of trade and commerce; and after cultivation is at " its height, those manufactures ought first to be encouraged, which work upon " materials of our own growth; and, last of all, those which employ foreign " materials."

7 The superior influence of the farmer, in promoting national circulation, is as important a discovery in politics, as that of Sir Isaac Newton, who first ascertained the principle on which the heavenly bodies circulated, was in astronomy. It is founded on the system of country banking, which ought to be encouraged, and placed on the securest possible footing. Those nations can alone be eminently, and permanently prosperous, whose governments will act upon that system.

8 It is supposed by some, that the merchants and manufacturers, did not pay so high a proportion of their profits, as was paid out of the incomes of the landed interest. But this has always been denied by the parties themselves.

9 It may be proper to state the amount of the income-tax, an. 1814, the last year that the assessments were imposed, under all its several heads:

1. Agricultural classes,		L.6,433,475
2. Commercial classes,		2,000,000
3. Professional classes,		1,021,187
4. Tax on houses,		1,625,939
5. Tax on the funds,		3,004,861
6. Provincial offices,	L.188,932	
7. Naval, military, and civil establishment,	924,312	
		1,113,244
Total gross amount,		L.15,198,706

The net produce was, L.14,545,279, of which foreign commerce did not probably pay half a million.

10 It is this respectable class of occupiers, who are most to be depended upon, for the improvement of a country. Small farms, at a low rent, may do without science, but great farms, with a high rent, cannot be carried on successfully, without the advantages of theoretical knowledge, united to skilful practice.

11 The 589,374 are those *who occupy land;* the 895,998 families include married servants, and labourers employed in husbandry, also agricultural mechanics, as plough-makers, &c.

12 It is hardly to be credited, how little the superior importance of agriculture, was known to the ministers and statesmen of this country, before a Board of Agriculture was established. Proofs of a circumstance of so extraordinary a nature, will be found in the Appendix.

13 Mr Curwen justly observes, that our internal or domestic resources have been greatly undervalued and neglected, while the benefits of foreign commerce have been greatly over-rated, and assiduously protected. This in a great measure may be attributed to a want of knowledge of their substantial interests, on the part of the landed representatives, when opposed in the legislative assembly, to the plausible representations, and sagacious adroitness, of commercial members, whenever, or wherever, their immediate or remote interests are likely to become affected. There is no species of property in this country, the intrinsic or relative value of which, is so little the study of those to whom it belongs, or the important and latent interests of which, are so little understood or so much neglected, as the surface territory of Great Britain.—*Curwen's Report*, p. 8.

14 But if this is bad policy, as it relates to Great Britain, is it not still worse *with respect to Ireland*, where agriculture is the chief source of wealth, and revenue; and where its population is principally supported by the cultivation and produce of the soil? During the late wars, Ireland was a flourishing country; her farmers had encouragement to improve and cultivate, and were well paid for their exertions; and the landed proprietors, had the means of contributing largely to the wants of the state, from the ample revenues which they enjoyed. But in the present state of agricultural depression, many branches of the community are either bankrupt, or reduced to distress; and it does not appear, that any part of it has been benefited.—*Remarks by Edward Burroughs, Esq.*

15 The only plausible objection, to a General Bill of Inclosures, is, that it

might have the effect, of drawing off capital and industry from rich land, which, in the end, would yield the best returns, and of having it wasted, in hazardous speculations, on barren soils. But on various accounts, this need not be apprehended. The lands of moderate fertility, would be laid down in grass, in which state they would accumulate strength ; and the poorer soils, in the interim, would, under proper treatment, be yielding crops considerable in respect of produce.

16 Dr Coventry observes, that the accumulated experience of ages is requisite, to perfect one's knowledge in several departments of husbandry. The difficult and extensive nature of the subject, the importance and the immense variety of the particulars relating to it, the vague, the doubtful, and even the contradictory details of alleged facts in almost every branch of it ; the obscurity of the principles on which are grounded several operations in agriculture, and other parts of rural business, and of those which influence, explain, and tend to regulate, in certain cases, the general practice of husbandry, augment the difficulties attending the acquisition of agricultural knowledge.—*Dr Coventry's Discourses*, p. 9.

17 The advantages of *an improved system of husbandry*, can hardly be too highly estimated. Where it is established, there is ample employment for the industrious labourer ; whereas, where the old system prevails, there is but little demand for labour. See this exemplified in Dr Rigby's Report, p. 96.

18 In the Appendix will be found an interesting account of the Bills of Inclosure, passed in the course of 40 years, preceding 1814, in two periods of 20 years each. During the space of the first 20 years, which was prior to the establishment of a Board of Agriculture, the number of these bills amounted only to 749, or 37 on average. During the second period of 20 years, posterior to the establishment of the Board, the number had increased to 1883, and the average to 94. The difference in favour of the latter period, consequently was 1134, and the average increase was 57. The difficulty often experienced in the importation of foreign corn, and the high price which it reached, joined to an increased circulation, must have contributed to these improvements, but the basis was laid, by exciting a general spirit of improvement, and establishing a Public Board, for the protection of Agriculture.

19 In these late reports and publications, which excel very differently, there is detailed, more useful and distinct information, on various branches of agriculture, and on rural concerns in general, than was in print before these were drawn up.—*Coventry's Discourses*, p. 187.

20 There is a list of those in England and Wales, in the Derbyshire Report, vol. iii. p. 651 ; and of those in North Britain, in the General Report of Scotland, vol. iii. p. 417. The meetings of such societies are of great use, by the information which they are the means of circulating, and the improvement which men derive from a combination of thought, and an inducement to compare and to examine.

21 On the Continent, particularly in France, correspondence respecting agriculture, literature, and other useful objects, is carried on through the medium of the Minister for Foreign Affairs.

22 The little prospect there is of having accurate experiments made, on farms of that description, is very ably explained in a communication from Mr Blaikie, the manager of Mr Coke's great farm at Holkham, of which the following is an extract : " These experiments are satisfactory, *so far as they go* ;—but certainly " not conclusive, because the produce was in no one instance, either weighed or " measured. This I much regret. But it appears to be almost impossible to " conduct such experiments, with a requisite degree of accuracy, upon a farm " establishment of such magnitude as that of Mr Coke at this place. For dur- " ing the hurry and bustle incident to collecting the harvest, the farm mana- " ger has so many important concerns to attend to, that he cannot devote any " portion of his time to superintending experimental objects ; and were he to de- " pute the management of such concerns to the labourers, it is not to be expect- " ed that they would pay the requisite attention."

23 There is an ingenious Essay on this subject, by Dr W. Richardson, in the Philosophical Magazine, vol. xlviii. p. 262.

24 Public lectures on agriculture, if discreetly composed, and intelligibly delivered, doubtless possess, among others, the following advantages: They are calculated to abridge the labours of the attentive inquirer, and to direct the general course of his researches, so that it shall be more easy, and more successful than otherwise;—to solicit his attention, not only to what is confessedly of importance, and generally studied, but likewise to many new discoveries and improvements as they rise;—and likewise to direct his thoughts to other particulars, which, though they may have hitherto obtained little, if any regard, are nevertheless of material consequence. Lectures also have a tendency to enliven the mind, to afford some relief from the tedious irksomeness of solitary study, and to fix more strongly in the memory, both the principles of agriculture, or rather husbandry, as a science, and its rules as a practical profession.—*Coventry's Discourses*, p. 3.

25 It may certainly appear at first sight extremely hard, that a large proportion of the community should be obliged to pay a price for the first necessary of life, so much above that at which it can be imported from other countries. But we must take into consideration the ruinous consequences which would result from a free trade in grain; for when individuals are left at liberty to pursue a gainful commerce, the general interest of the community operates little on their proceedings. Thousands would be deprived of work, the distresses of our population would be fearfully augmented, and whilst bread might be cheaper, the many, from want of labour and adequate wages, would have it less in their power to become purchasers. To shut out foreign grain, may be an evil, I mean not to question; yet much as I deplore the necessity for importation, I verily believe, that it is against the general interests of the working classes, to suffer foreign corn to come into the country, below the average price at which it can be raised in Britain.—*Curwen's Report*, p. 7.

26 In the 8th Report of the Commissioners for Highland Roads and Bridges, ordered to be printed in March 1817, there is an abstract of the proceedings of these Commissioners, since the year 1803, a period of about 14 years. During all that time, they have only expended about L.200,000 *of public money*, the rest arising from private contributions, with which they have made, about 950 miles of road, and 1100 bridges. That includes L.42,175 for surveys, and expense of management. This is only at the rate of about L.14,285 per annum. How any one can question the policy of continuing so trifling an expenditure, while required in any part of the united kingdom, can hardly be credited. Frederick the Great, from the moderate income which Prussia afforded in his time, laid out no less a sum than L.300,000 per annum, in promoting such public improvements. What then ought not to be done with such a revenue as Great Britain furnishes?

27 These suggestions have been fortunately adopted, an Act having been passed in June 1817, " To authorise the issue of Exchequer bills, and the ad-" vance of money, to a limited amount (L.1,500,000), for carrying on Public " Works and Fisheries in the United Kingdom," &c. which, there is no doubt, under proper management, will be attended with the most advantageous consequences.

28 The Harbour Commissioners have received in all, from the balances arising from the forfeited estates in Scotland, L.25,133. With only L.20,010 of that sum, they have already, either made, or improved ten harbours and a canal, the remaining expense being paid by subscription. Is it possible to lay out public money more advantageously? and why should not so useful an expenditure be continued?

29 The Bedford Level Corporation is an example of that sort in England.

30 Cromwell followed the same system. To promote agricultural improvement, he gave L.100 per annum, (a large sum in those days), to a farmer of the name of Howe, in Hertfordshire, to encourage him to introduce turnips and clover into that county.—*Herts Report*, p. 55.

31 In the works of the celebrated Count de Hertzberg, a particular detail is given of the measures taken by Frederick the Great, for promoting the agricultural prosperity of his dominions, and the particulars of all the immense sums bestowed by him for that purpose. They are detailed, in "Miscellaneous Essays," by Sir John Sinclair, printed an. 1802, p. 260.

32 Had agriculture been sufficiently encouraged, such a breadth of land would have been brought into cultivation, as would have rendered importation unnecessary; and our own farmers would have derived the whole benefit of those high prices, which the deficiency of their crops required.

33 Any government, whatever its form may be, must always be in a precarious state, when its agriculture ceases to furnish means of subsistence for its inhabitants; and it is acknowledged, that the fear of famine, has as often dictated to potentates, the necessity for making peace, as either conquests or defeats.—*Curwen's Report,* p. 4.

34 Communications to the Board of Agriculture, (Essay on Waste Lands, by the Bishop of Llandaff), vol. vi. p. 12.

APPENDIX.

No. I.

ON THE SIZE OF FARMS.

The result of the discussion regarding the size of farms, is given in the Code of Agriculture, Chapter I. Section 7, p. 41. A minute investigation of that subject, however important, appeared to be inconsistent with the nature of a work of so condensed a description, as the Code itself. It was therefore thought more advisable, to print separately, the arguments in favour of great and of small farms, in a number of the Appendix, for the information of those, who were desirous of having the question minutely investigated.

Arguments in favour of Large Farms.

1. Where a farm is of a large size, less expense is incurred in building houses and offices, and in keeping them in repair, than if the farm were divided, and several sets of houses, &c. were erected for the accommodation of two or more farmers. 2. The inclosures on a large farm, being on a greater scale, are originally made, and afterwards kept in repair, at a less expense; much ground is thus added to cultivation, and less shelter is given to the vermin with which hedges and walls abound. 3. There is also a saving of expense in housekeeping, when two farms are united into one, the amount of which must vary according to circumstances. 4. The saving in the expense of cultivation is considerable. When a farm of 200 English acres, is united to one of 300, the work of a pair of horses and a ploughman will be saved; fewer instruments of husbandry are also necessary; in particular, one threshing-mill may be sufficient. 5. Though there are exceptions to that rule, yet in general, from superior capital, on large farms the land is much better cultivated, more effectually drained, and more improved by extraneous manures, which small farmers cannot afford to purchase to much extent, or to convey to any distance. 6. A much greater quantity of disposable produce is sent to market. The small farmer and his family indeed, raise so little, and consume so much, of the produce of the land which they occupy, that the surplus they can spare, must always be trifling; and, in unfavourable seasons, none can be expected. Hence it is only by means of large farms, or a number of moderate-sized ones, that great towns or populous districts can be supplied, in sufficient quantities, with such articles of primary necessity as grain and butchers' meat. In regard to

the latter in particular, it is generally sold by the large farmer, in a fattened state, which is seldom done by the small one. 7. The live stock on large farms, is confessedly of a superior quality, because a large farmer can better afford to purchase the best sorts, and to maintain them afterwards: the implements of husbandry are likewise of a more improved description, and capable of performing their work in a superior manner. 8. The labour on a large farm can be better subdivided than on a small one, by means of which, critical periods may be caught, more strength of labour can be applied to particular parts of the farm when wanted, and the work may be done better, and with more expedition, in an adverse season. 9. The large farmer has full employment, independent of manual labour. He has enough to do in superintending others, instead of working with his own hands; and if he should employ himself in doing a job at one part of his farm, he would lose more than the value of his own labour, by his servants being either idle, or ill directing their labour, in other places. From thus having full employment, he is not under the necessity of engaging in other undertakings, which not only would abstract his attention from his farm, but would often be attended with real loss. 10. A farmer with a large capital, has usually enlarged ideas, which generally expand with the extent of his possessions: he usually receives a superior education, and understands better every branch of his profession: he is able to travel about to obtain useful information, and having more enterprise, and fewer prejudices to subdue, he is more ready to adopt new improvements *. 11. On a large farm, a greater variety of practice can be introduced, such as pasturing a proportion of the farm alternately; and while the large farmer, may be both disposed and enabled to change his intended system, should an unfortunate season, or some other incident, render it necessary, the farmer on a limited scale must continue in the trodden path, often in opposition to the true principles of his profession. 12. Large farms are favourable to the improvement of land in an inferior or waste state. The small farmer generally leaves it as he finds it; whereas, when a great farmer, with a considerable capital, gets such land into his possession, on an improving lease, he soon renders the inferior land he occupies, or even the neighbouring waste, nearly as valuable as the old cultivated soil. 13. Large farmers, when they are active, spirited, and intelligent, are the fittest persons to try experiments, and to prosecute them to the necessary extent; small farmers cannot afford it, and gentlemen farmers, (though there are exceptions to the rule), seldom give such unremitting attention, as is necessary for insuring success. 14. Many operations on a large farm can be done better, and,

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* There are few branches of natural philosophy, chemistry, natural history, mechanics, &c. which may not be profitably applied to a large farm. To take advantage of these, the occupier ought to be a man of education, and competent to his own progressive scientific improvement, by reading, observation, and intercourse with intelligent men. He may thus be enabled, to discover some new processes, by which his own immediate profit, and the general interest, may both be forwarded.—*Rigby's Report of the Husbandry of Holkham*, p. 88.

in proportion to their importance, at a cheaper rate, than on a small one. For instance, where a large flock of sheep is kept, or a number of cattle, careful and intelligent servants may be hired for attending them, which no farmer on a small scale can afford. A large farmer can also sell at market, in the same space of time, ten times the number of cattle or sheep, or ten times the quantity of grain, that any small farmer can have to dispose of; and in general, has better information regarding the state of the markets. 15. The large farmer, possessed of all these advantages, in addition to his superior capital and credit, can generally afford to pay a higher rent, with more punctuality, than the small farmer; from whom the rent which he agreed to pay, cannot often be exacted without compulsion. 16. The large farmer pays more taxes to Government for his house, windows, and horses, and for every article of his consumption. Indeed, small farmers, whose rents were under L.50 a year, were considered by Parliament, and justly too, to be in so humble and poor a state, that they were not made liable to the payment of the income or property tax; and if all the farms in the kingdom had been under that amount, Government would not have received a single shilling from the occupiers of land, on account of that tax. 17. Large farms, in the occupation of wealthy renters, are a species of magazines or repositories, kept for the use of the public, but without any of those mischiefs which would attend them if they were a public concern *. In the last place, respectable farmers are a most important link in the great chain of society, rarely to be found in any country, Great Britain excepted;—a class of individuals, whose habits of industry, intelligence, and spirit, and the extent of whose capital, which it has required centuries to accumulate, form a species of bulwark, materially tending to preserve the existing order of society; but if that bulwark were once laid prostrate, it would baffle human policy, without the existence of similar circumstances, ever to renew it †.

Dr Rigby, in his Report of the Husbandry of Holkham, after observing that some of Mr Coke's tenants occupy not less than 1200 acres of arable land, maintains, that such large farms, will always have the advantage, in productive and profitable cultivation, over small ones, as large manufactories, and extensive mercantile establishments, with large capitals, will be superior, in relative profit, to those, which are carried on with more limited capitals, and on a smaller scale ‡. He adds, that the improvements which are acknowledged to have taken place in agriculture, are unquestionably to be dated from the time when the land began to be cultivated by individuals, on an extensive scale.

Mr Blaikie likewise remarks, that where the system of folding sheep on turnips is practised, large farms are indispensable. That excellent system § is necessary, for maintaining *light arable land*, in

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* Gloucestershire Report, p. 54.

† Husbandry of Scotland, vol. ii. p. 150.

‡ Dr Rigby's Report, p. 116.

§ That system is very different from the plan of folding sheep from upland a profitable state of cultivation, more especially when situated at a distance from manure, and markets. A flock of sheep however, cannot possibly be kept with advantage on a small farm. The greatest storehouse in the kingdom, (the county of Norfolk,) depends for its fertility on this mode of consuming turnips. Though good land therefore, situated near large towns, and tenacious soils, in other situations, may be cultivated in moderate-sized occupations, yet, in the great corn growing districts in the southern parts of the kingdom, the farms must be large, for the purpose of raising a great surplus produce, otherwise the inhabitants of the metropolis, and of other large towns, cannot procure food raised by British skill and industry, but must trust to the precarious supplies of foreign countries for their subsistence,—a state of dependence, to which any nation, who can produce in its own territories, the indispensable necessaries of life, ought not to submit.

Arguments in favour of Small Farms.

Such are the arguments advanced in favour of *large farms.* They are controverted by those who argue, in favour of farms of small or moderate dimensions, on the following grounds:

In answer to the *first* of these conclusions, they contend, that the saving of expense in building three or four farm-steads of moderate dimensions, instead of one on a large scale, is in some measure imaginary: That the accommodation for cattle must be nearly the same, whether 100 cattle are kept in one cow-house, or in four or five. A tenant occupying 1000 acres, would expect a better dwelling-house than one renting only 200 acres. But though four or five inferior houses would cost more than a single house for a large farm, yet the expense of erecting additional houses for servants, would go far to make up the difference; and the additional roads on the large farm, above what would be needed in four or five small farms, would exhaust the superior expense of the dwelling-houses. 2. The additional fences on small farms occupy more ground, and shelter vermin. But surely the shelter of thorn fences will enhance the value of a farm, by screening it and the cattle from the severity of the storms, so usual in these northern latitudes. 3. If farmers were all to live in the style of gentlemen, five families on 1000 acres would expend more money than one family. But if farmers live as they ought to do, only in a small or moderate degree better than their own servants, and labour like them, the expense on that score would only be small, and would be much more than compensated by the labour they perform. 4. One large threshing-mill would not cost so much as four or five mills on even a smaller scale; but in regard to horses, ploughs, harrows, carts, and all ordinary implements of husbandry, the expenses must be nearly the same, whether the 1000 acres are farmed by one or by five tenants. 5. It is not true that land is better cultivated on large than it is on small farms; but in many cases the reverse. Neither is there any circumstance connected with small farms, that can warrant an opinion

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pastures, upon the arable land in the vale, which is highly exceptionable, as it impoverishes large tracts, for enabling smaller portions of land to produce grain.

a priori, that they are not to be even better cultivated than those that are large. 6. If it is meant, that a farm of 1000 acres raises more produce than one of 200 acres, the remark must be correct. But if the 1000 acres were divided into four or five farms, the produce, instead of being diminished, would probably be increased. 7. The live stock upon large farms is not in general of superior quality, nor are the implements of husbandry more improved, than they are on smaller farms, but rather, in both cases, the reverse ; at least they are in general better taken care of on small farms, where every thing is more under the eye of the farmer and his family. 8. If a greater number of people can be brought to assist at any particular job, in cases of emergency, on large farms, than can be collected on small possessions, the work to which they are called must be great in proportion, unless we suppose, that those who farm on a large scale keep a greater proportion of people, than are kept by small farmers. 9. No farmer can himself oversee all his servants and labourers, when scattered over 1000 acres of land. He must employ several overseers, to prevent his servants from being "either idle or ill directed." But one who farms 300 acres or so, can, by going at the head of his men, not only direct their operations, and save the expense of a bailiff, but by working along with them himself, has a good chance of getting more work performed, than if he were not present. 10. It is contrary to almost uniform experience, to maintain that a large capital gives more enlarged ideas, than can be enjoyed by the holder of a more limited stock. On the contrary, there is probably not a farmer in a thousand, who employs ten servants, but some of them, though they may be deficient in the punctilios of good breeding, yet may have acquired as correct ideas on the theory and practice of husbandry as their masters. 11. Every variety of practice, such as pasturing part of the lands, and every experiment a farmer could wish to try, may be introduced on a farm of 200 or 300 acres, as well as upon one of 1000 acres, and with still less risk of disappointment. 12. Large farms are not nearly so favourable to the improvement of waste land, or soils of inferior quality, as farms of small or very moderate dimensions. 13. Farmers who act on a moderate scale of operation, will as readily try experiments, and with still less risk, than can be done by those who farm 1000 acres. 14. One shepherd and a dog may tend all the sheep that can be grazed on the farm of 1000 acres ; but it is not to sheep, but to arable farms, that these remarks refer. 15. So far from large farms bringing a higher rent, in proportion to their extent, than those that are small, the reverse is the case. 100 acres of arable land will almost always give a higher rent, when let in two, or even in three possessions, than when let in one. The farms in the western arable districts in Scotland, are generally of small dimensions, from 50 to 150 acres, and scarcely one in a thousand larger than 300 acres of arable land ; and yet with all the disadvantages of a worse climate, which compel them to keep much of the land in pasture, these farmers pay higher rents per acre, than are paid for land of similar quality in the Lothians. The farm of Draffen, on the estate of the Duke of Hamilton, extending to 600 acres arable, was, till lately, let in one farm, to a farmer bred in Lothian. But when his lease terminated, the farm was divided into five farms, and let at more than double the rent that could be obtained for it in one farm. Many such instances could be mentioned. The finest farm in the west of Scotland, (Girvan-mains, in Ayrshire), was long occupied as one farm, at the rent of L.1600 for 500 acres ; but the proprietor has recently divided it into three farms, and gets more rent than he could obtain for it from one tenant. 16. Large farms may pay more taxes ; but however beneficial that may be to the revenue, it is no advantage in an agricultural point of view. Farmers never consider the payment of taxes a benefit, but the contrary. 17. If large farms are magazines or depositories of farm produce, they are so much more dangerous in raising prices of grain. Lastly, Farmers no doubt form an important link in the chain of society, whatever be the extent of their possessions ; but when they attempt to raise themselves above the sphere of their profession, and aim at becoming gentlemen, they ought to discontinue farming, and let others who are more industrious, and less ambitious, occupy their possessions. High life below stairs is far out of place among farmers.

But if these objections to large farms should not be satisfactory, their bad effects on the condition of a numerous and valuable portion of the labouring population, would render it desirable, that a large proportion of the arable land should be at all times kept in farms of small or moderate dimensions. Wherever large farms generally prevail, nine out of every ten of the population of the district are reduced to the condition of servitude, from which it is almost impossible that they can ever extricate themselves. A hind in Lothian, or wherever there are no farms of small or moderate dimensions, must continue in that capacity during life, and his posterity must hold that station for ages to come ; whereas the farm-servants in the western arable districts of Scotland, if they continue to be frugal and industrious, can soon become farmers on a small scale, and if prudent, they may raise themselves to be farmers of the first rank. Many have done so, and some have raised themselves to the rank of proprietors. Another unreasonable conclusion come to or implied in the arguments for large farms, is that those who occupy them are wealthy, active and intelligent ; and that all others are poor, indolent and ignorant. Now, the truth is, that although a man farming 1000 acres has ten times the capital of one who occupies 100 acres, the two are on an equal footing ; and intelligence is not attached exclusively, either to wealth or to length or breadth of a farm ; and refinement of manners is out of the question among farmers.

Without, however, pursuing the controversy farther, it may be concluded, that where a proper course of farming, suited to the lands and local circumstances, is adopted, and due attention paid to the labouring and cropping of the lands, the public interest is not materially involved in the diversity of the size of farms. If all farms were to be reduced to one size, whether great or small, it would be productive of much inconvenience. If all farms were to be small, no room would be left for the exercise of genius and enterprise ; and if all the farms were to be large, a sufficient number of tenants, possessed of capital and mental abilities for such weighty concerns, could not be found ; while all persons of moderate fortune, however well qualified they might otherwise be, would be driven off the field, and reduced to the condition of hinds and labourers. There is much diversity in the taste and genius, as well as in the wealth of farmers. Some are poor and others rich; some timid and others enterprising; some have capacities for conducting great and important concerns, while others have neither abilities nor inclination for such undertakings. And since men are naturally, or from education or other circumstances, so different in respect to abilities and inclination, it would be wrong to fix either a minimum or maximum in the dimension of farms. There is indeed an advantage, in having various sizes in the same district, so that enterprising individuals, may have an opportunity of increasing their occupations, in proportion to their increased means of cultivating them.

Result.

The size of farms to be recommended, ought, in a great degree to depend, upon *the circumstances of a country*. What is a proper size in one district, is not so in another; and what is a proper size at one time, is not so at another, even in the same district. On the whole, however, that size, whether small, or moderate, or large, is to be preferred, for which there is, in any particular district, the greatest demand at the time. This demand insures, from competition, an adequate rent; and while the proprietor thus obtains the value of his land, the public are also benefited, the greatest possible produce being procured from the soil, owing to the superior industry and exertion required on the part of the farmer.

No. II.

HINTS ON VEGETATION,—THE AGENTS NECESSARY FOR THE PRODUCTION OF PLANTS,—AND THOSE WHICH ARE INJURIOUS OR DESTRUCTIVE TO THEM.

By Sir John Sinclair.

THE object of any inquiry into the nature and principles of vegetation, *for practical purposes*, must be, to ascertain in what manner those plants, which are necessary for the use of man, or contribute to his comfort, can be cultivated to the greatest perfection. For that purpose it is essential to know, what agents are necessary or useful to vegetation, on the one hand, or, on the other, injurious and even destructive. The former may be considered under the following general heads, namely, Earth or Soil, Air, Water, Light and Heat, Manures or dead organized Matter, and Cultivation. The latter may be restricted to two points, Mineral or noxious substances in the soil, and vermin.

It may be proper to add some remarks, on the means of raising new varieties of plants, which, though hitherto considered as a philosophical speculation, may yet be found productive of important practical results.

1.—*Of the Agents which are necessary or useful to Vegetation.*

1. *Earth.*—It is sufficiently obvious, that a soil is necessary, not only for the purpose of enabling plants to grow steady and upright, and thus to receive whatever nourishment the air affords, but also for containing in it, the most essential parts of the food on which they subsist, which they extract from the soil by their roots.

Many aquatic plants indeed grow in water, but the greater part of them have their roots in earth. Marine plants grow upon bare rocks, or stones; but then it is well known, that they are fixed to them, and that they derive their food from the sea-water in which they live. Some authors have contended, that plants are actually nourished by the earth alone; and Tull, in his Treatise on Horsehoeing, published in 1733, advanced the doctrine, that minute earthy particles supply the whole nourishment of the vegetable world *. But such an idea is sufficiently refuted by various experiments, made with great care, and, in particular, by the small portion of earth that is found in plants; so small indeed, that the very water which they imbibe, from the particles of earth which it contains, can account for it. It is only those particles of earth, held in solution, which plants can imbibe, and the earth itself is, in no other respect requisite for the growth of plants, than as a laboratory to prepare their food, and as a bed in which their roots may range, and procure their sustenance, Duhamel thought, that by dividing the soil as completely as possible, any number of crops might be raised in succession from the same land; but he was soon convinced, that his opinion was erroneous, and that no single material afforded the food of plants.

2. *Air.*—This agent is another essential requisite to the growth of plants, and is as necessary for their healthiness and existence, as for that of man. Pure air is likewise required, to bring various plants to perfection; for there are many fruit trees, and vegetables, that will not grow in the contaminated air of London, or its immediate neighbourhood, but will thrive at some miles distance. Some respectable philosophers indeed, have entertained an idea, that atmospheric air is the sole, or at least the principal food of plants. It is contended, that trees, whose branches are extended in the air, were not furnished with foliage for ornament merely, and that their leaves are analogous to the lungs of animals, and act in the same way. The advantages of fallowing also, according to some, prove, that the earth extracts nourishing particles from the air, and is fertilised by its influence. Such doc-

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* M. Giobert's experiments are decisive as to this point, for having mixed pure earth of alum, silex, calcareous earth and magnesia in various proportions, and moistened them with water, he found that no grain would grow in them; but when they were moistened with water *from a dunghill*, corn grew in them prosperously. Hence the necessity of the carbonaceous principle, for the purposes of successful vegetation, is apparent.—See Kirwan's Essay on Manures and the Food of Plants, p. 40.

trines however, ought not to be carried too far *, for air, however important, is not alone sufficient for the purposes of perfect vegetation. On this subject, Sir Humphry Davy's opinion seems to be correct, "That "all the varieties of substances found in plants, are produced from the "sap;—that the sap is derived from the fluids in the soil,—and it is "altered by, or combined with principles derived *from the atmos-* "*phere.*" In regard to the influence of air on vegetation, a most intelligent physiologist observes, "*That both in plants and animals,* "*oxygen gas is uniformly converted into carbonic acid, during the* "*exercise of the respiratory function; and that by this chemical* "*change in the air, the latent or specific caloric is set free, and en-* "*ters into the vegetable and animal systems* †." It is thus chiefly, that the human frame, acquires heat internally.

3. *Water.*—That water is essential to vegetation, seems to be universally admitted. Indeed the luxuriancy of the growth of plants, connected with the presence of moisture, led Van Helmont and others to entertain the opinion, that water is the real and efficient source of vegetation, and that all the various products of plants are generated by water alone. This opinion is erroneous, for no single substance affords exclusively food to vegetables. *Earth, air* and *water*, are all necessary for that purpose. "*The earth*" is the laboratory in which the food is prepared, and retained for use:—The germination or growth of the seed of plants does not take place, without the presence of that valuable substance which "*the air*" contains, namely, *oxygen gas;*—and the beneficial products to be found in putrescent manures, cannot be taken up by the roots of plants, without the assistance of "*Water.*" Thus they all separately and respectively contribute, in different ways, to promote the process of vegetation.

Water is likewise of importance, as supplying the principal material of the sap, which may be called the blood of plants, without which they would perish, many instances being known of trees dying, when their sap was exhausted. The great improvements which are made by the mere watering of land, likewise prove the powerful effects of water. But it seems more favourable to the growth of grasses than of grain, for though, by irrigation, perpetual crops of grass could be obtained, yet, experience has proved, that land, if cropped with grain, was completely exhausted, though regularly watered, which could not have been the case if water was the sole food of plants ‡. It is certain, however, that a large proportion of every plant consists of water, and that water is the ve-

* Dr Bell thus proved the importance of air to vegetation. In the winter season, he covered several young trees with varnish, and at the same time wrapt them in wax cloth, leaving the tops of the branches only exposed to air. They remained in this situation during the whole summer, when some of them lived, though in a languid state, and put out a few leaves; but those from which the air had been more accurately excluded died, without a single exception.—*Manchester Memoirs*, vol. ii. p. 421.

† See Ellis on Air, part ii. printed an. 1811, p. 374; also, his very valuable work, on Vegetable Physiology, in the Supplement to the 5th edition of the Encyclopædia Britannica.

‡ Some philosophic experiments, as those of Dr Woodward, prove, that plants *will grow*, with the application of pure rain water alone; but the question is, will rain water alone enable them to produce seed in perfection?

hicle, by which all the food, *which the plant receives from the root,* is conveyed to it. However beneficial water is, all spring waters are not equally so. Some waters are certainly hurtful, particularly to young plants. Mineral waters, as that of Cheltenham, &c. are known, by experience, to be injurious.

4. *Light and Heat.*—These two substances are in general so much combined, that it is very difficult to distinguish the influence they respectively have in the process of vegetation, nor is it necessary for the farmer to enter into these nice distinctions. It may be sufficient to remark, that in the opinion of Mr Knight, the more perfect plants never generate an atom of true sap, (*vegetable blood,*) except under the operation of light *, and that whenever light is wanted, little vegetable blood, comparatively, is produced. Hence, in crowded crops, except in very bright seasons alone, very moderate quantities of seeds are usually generated.

As a proof of the importance of light to plants, it has been remarked, that if put into a dark place, they always bend to any hole or window where any light is admitted. It is certain that light is necessary, to complete the formation of oil in the seeds of oleaginous plants, and that it renders fruits much sweeter, and higher flavoured than otherwise they would prove. Light also greatly increases the amount of saccharine matter in the sugar cane; for the same plants, which, if exposed to the light, would produce large quantities of sugar, if grown in the shade, are in that respect greatly deficient.

In regard to heat, few plants are calculated for very cold countries, and those are seldom valuable; whereas, the variety of plants produced in hot countries is great, and the uses to which they can be applied are numerous. Trees, which seem dead from the severity of the cold seasons, are revived by the warmth of the spring, and strengthened by the heat of summer. They thus acquire fresh life and vigour; and are enabled, by the aid of light and heat, to bring their blossoms, seed and fruit to maturity.

5. *Manures, or dead organized matter.*—It seems to be a part of the beautiful economy of Nature, that nothing should have lived in vain, and that the destruction of one plant, or animal, should furnish food for others. Hence, however useful earth, air, water, light, and heat are, to the growth of plants, it is at least questionable, whether they could ever come to perfection, without the aid of matter that had been formerly organized †. The richest soils, it is well known, are full of dead animal and vegetable matter; and there is no soil that will not produce plants, if a sufficient quantity of dead animal or vegetable substances be added to it. Under this head are comprehended, all those enriching and nutritious manures which are found so useful in

* An ingenious treatise on the subject of light, written by Von Uslar, a German author, translated by G. Schmeisser, in one small octavo, was printed at Edinburgh, an. 1795.

† Dr Pearson contends, that no living thing, whether plant or animal, can grow, *or live,* without supplies of matter that has been alive, or, in other words, that living animals and vegetables, must derive their food, from dead animals and dead vegetables. This doctrine is in general correct, but some recent discoveries by Mr Knight, prove, that it does not universally hold good, some plants of the *Conferva* family forming an exception.

cultivation; substances must be frequently renewed, in order to restore to the soil, materials which have been absolutely consumed in the process of vegetation.

In regard to those saline substances, on the advantages of which some authors have laid so much weight, it does not appear that salt is essential to the growth of any species of plants, the marine alone excepted; and there are many productive soils, in which little or no salt can be traced. Salt however, though not essential, is of use to vegetation. It may operate upon plants, as it does upon the human body, by assisting to digest the food, without furnishing nutriment itself. It is of use, mixed with dung, as an assistant to putrefaction. In fact, it promotes vegetation, as mustard, ginger, &c. are useful in human food, contributing to render other things nutritious, by exciting action in the stomach and other organs of digestion and assimilation. It is also serviceable by attracting moisture, destroying vermin in the soil, and putrefying the roots of weeds or other plants which it first encounters, by which nourishment to the succeeding ones is supplied.

6. *Cultivation.*—The culture of the earth is essentially necessary for the growth of plants to perfection. By dividing the particles of the soil, the roots can more easily penetrate it, and they can more readily suck in the moisture and nourishment which it contains. By proper culture also, weeds, or useless plants, are extirpated, whilst stirring the earth, admits more air and moisture to those which have been sown. Young trees certainly thrive much better, if the soil in which they are planted, has been previously ploughed so deep, as readily to admit their roots and suckers. Even after they have been planted, it is of service to cultivate potatoes, and other roots, among the young plantations.

2.—*Of the Agents which are destructive or injurious to Vegetation.*

The obstacles to vegetation which it is necessary here to discuss are, mineral, or noxious substances in the soil, and vermin.

1. *Mineral or noxious substances in the soil.*—There are certainly many substances in the soil, noxious to vegetation, in particular those of a metallic nature. Where mines of iron, lead, or copper are near the surface, many plants will not grow to perfection, which is known to be the case at the Lead Hills in Scotland, &c. Clay-slate, shale or *till*, in which there is a great deal of iron and alum, is so unfavourable to vegetation, that any considerable quantity of it would destroy the fertility of the richest soil. Fallowing, or exposure to the air, and the use of lime, will, it is supposed, correct the noxious qualities of those substances.

There is also an astringency or acidity in peat, so injurious to vegetation, that until any quality of that nature is subdued, though that species of soil is a mass of vegetable matter, yet nothing but heath, and other useless plants will grow in it.

2. *Vermin.*—Plants are also much injured, by the various sorts of vermin with which both the earth, and the air, abound. Those which inhabit the earth, it is supposed, may be destroyed by salts, by

acids, or by lime. In regard to the myriads of insects with which the air abounds, it is more difficult to point out a remedy. It is said, that in some parts of the Continent, they surround their gardens with a broad row, or belt of hemp, the smell of which is particularly noxious to insects *. Sometimes the depredations of vermin are occasioned by the weakness of the plant, and the poverty of the soil in which it grows; for insects are more apt to attack a weakly, than a vigorous plant. This is supposed to have been the case in regard to the celebrated Hessian fly of America, which originated from bad culture during the war, in consequence of which the wheat became stunted and diseased. The mischief vanished with good cultivation; and indeed it is asserted, that fields, properly manured, were never affected by it, though in the immediate neighbourhood of those which were.

3.—*On the Means of raising new Varieties of Plants and Vegetables.*

It has long been known, by those who have studied the theory of vegetation, that by applying the pollen from the *stamens* of one species of tree or plant, to the *pistil* of another of the same sort, the seeds which result from this cross impregnation, produce new varieties. For instance, by thus admixing the farina of two different varieties of the potatoe, *when in flower*, new varieties are produced, whereas it is ascertained, that no alteration in the plan of cultivating the potatoes themselves, or any change of soil, ever can have that effect. The same system furnishes the only means by which the production of new kinds of apples, and fruits, can be obtained; for let any sort of fruit tree be propagated, in whatever numbers, by engrafting or budding, and on whatever stocks, or by whatever other means, it will create no new variety in the fruit. The change takes place in the seed, and can only be discovered in the next generation. There can be no doubt therefore, that by great attention, and skilful management in crossing the pollen of species, important changes may be produced, in the habits and general properties of vegetables or of fruits, as well as in animals, and that new varieties, of great value, may be procured †.

Conclusion.

These cursory hints have been sketched out, for the purpose of giving some general idea of the principles of vegetation, and the means of promoting the growth of plants, and of preventing those injuries to which they are liable.

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* The celebrated Bergman prevented the *Phalæna brumata*, laying its noxious eggs in the buds of blossoms, by tying the tarred bark of a birch round the stem of fruit trees.—*See Thunberg's Travels*, vol. iv. p. 285.

† This intricate subject is very fully explained in Dr Darwin's Phytologia, Sect. 7, "On the Organs of Reproduction of Vegetables." Mr Knight of Downton, in Herefordshire, the distinguished President of the London Horticultural Society, has likewise discussed this subject with his usual ability; and we are much indebted to Mr Neill, Secretary to the Caledonian Horticultural Society, for the useful information he has given regarding it. See Memoirs of that Society, No. 10. p. 219.

On this subject, it has been justly observed by the intelligent Dr Coventry, that such investigations would not only become a source of curious and interesting amusement to those engaged in agriculture, but might likewise prove of real advantage, by furnishing them with many useful hints, for the profitable improvement of their art. Many errors in the cultivation of land have arisen, and been persisted in with much ultimate loss, from ignorance, or mistaken notions, about vegetation, and the circumstances connected with it.

He adds, that the quantity of accurate information on the subject of vegetation, of which we are yet possessed, when separated from uncertain conjecture, it must be admitted, is extremely small. Still, however, the little which has been already discovered, has proved of signal advantage in gardening; and there is no reason, why it should not likewise contribute, in as great a degree, to the improvement of agriculture, which is a more extensive, as well as a more economical mode of cultivating the soil.

To complete however, so important, and so extensive an investigation, would require the united efforts of a number of scientific and practical men, with a sufficient quantity of land at their command, to bring various important particulars to the test of experiment; and to render such experiments truly useful, this ought to be done on a great scale, and exposed to atmospheric influence. The philosophic experimenter may work successfully in his laboratory, with the object always in his view. But the secret processes of vegetation are carried on in the dark, exposed to the various and uncertain influences of the atmosphere, and require in general, a considerable period of time for their completion. Hence the difficulty of determining, on what peculiar circumstances success or failure depends; and hence a diversified experience, carried on for a number of years, and in the open air, can alone afford a sure foundation, for such specific conclusions as can be confidently relied on *.

Additional Hints on Vegetation, and the Culture of Potatoes.

Convinced of the importance of light to the production of crops, Mr Knight has tried a peculiar method of raising potatoes, by which he procured the enormous crop of 670 bushels, (80 pounds each), from an English acre, equivalent to 804 bushels per Scotch acre. His system is, to plant large tubers, weighing generally, (if the variety of the potatoe be large), at least half a pound each. These sets he does not put at a greater distance, (from centre to centre), than six inches in the row; but he leaves wide intervals between the rows, not less, when the soil is good, and the varieties of luxuriant growth, than 4 feet. Special care is taken to make the rows lie from south to north. Under this mode of treatment, very large plants, presenting a wide extent of surface to the light, very early in the summer, are generated. The wide intervals between the rows, admit the free operation of light upon the plant, afford space for clearing them of weeds, and allow, without impediment, the beneficial influence of the atmosphere. The crops

* Kirwan on Manures, p. 4.

of potatoes, under this system, are not only more certain and abundant, but also of superior quality; for the plants, having acquired a large growth very early in the summer, the produce is of course perfectly ripened early in the autumn. If the potatoes are of a dwarfish sort, the rows ought not to be more than 2 feet distant from each other, nor the sets more than 3 inches apart in the rows. In various instances, potatoes have been planted, so as to leave a distance of 4 feet between the rows, and with advantage. But as Mr Blaikie justly observes, the success must greatly depend on the soil, and on the season. If a trial is made on a light sandy soil, facing the sun, and the rows ranging from north to south, the plan may not answer, should the summer prove hot, and dry, though heavy crops of potatoes, may be raised in rows at that interval, upon rich deep loams, *in low situations.*

An intelligent farmer in Mid-Lothian found, by experience, great advantage from cultivating potatoes, at 4 feet distance, not only in respect to their quality and the quantity of produce, *but also in regard to the improvement of the soil, for the succeeding crop.* He attributed this beneficial effect, to the soil being entirely shaded from the sun by the luxuriance of the foliage.

It may be proper to add, that Mr Knight has ascertained, that large tubers give very strong stems, which cause the leaves, if the variety have *proper* habits, to be held up to the light in their first position. The leaves, under those circumstances, do not fall upon or shade each other, and remain therefore, through the whole season efficient. He considers the perpendicular direction of the stem to be important, as gravitation certainly acts with much power, upon the motion of the fluids of plants.

Mr Knight is trying some important experiments, with varieties of the potatoe *which do not blossom.* Some of these sorts grow and ripen early, while others grow and ripen late. The possession of varieties with these different habits, must tend to render the potatoe crop less subject to variation or failure.

There is no branch of agriculture, the improvement of which is of so much public consequence, as the culture of the potatoe, as, by the abundance of that crop, any deficiency in the production of other articles of food, may be most effectually supplied.

No. III.

OF LEASES *.

The relative situation of landlord and tenant, has undergone a very material change, from what it was in ancient times. Originally the lease was an agreement for mutual protection and defence, or of a mi-

* The general nature of the connexion between a proprietor and his tenant has been already explained, chap. i. sect. 8. p 51.

litary character. Its principal use was, to express the consent of the proprietor, that the tenant should have possession of his land, subject to military services; and, instead of a mutual deed binding on both parties, it was a mere grant of occupancy to the tenant. At that time the tenantry, had seldom any capital to employ on improvements, and their trifling exertions for that purpose, were insufficient to give importance to their rights. The modern contract of lease is of a very different description. It has become *an agricultural contract,* by which the tenant stipulates to employ his capital, skill and industry, in the cultivation of a farm, and concerts a plan of operations with the proprietor, from which a profit is likely to be derived, to be divided between them, in proportion to their respective interests, and the contributions of each to the common concern. The interest of the tenant, under such an arrangement, is very different from that of the tenant under the old system of leasing; and sound policy, as well as justice requires, that while, on the one hand, he shall be fully secured in the possession of the rights, powers and privileges for which he stipulates, so, on the other, he shall be held bound to fulfil the counter-obligations which he has undertaken to perform *.

We shall proceed to consider the means by which these objects are to be obtained, under the following general heads: 1. The manner of settling the contract between the parties;—2. The terms of entry, and regulations connected therewith;—3. The duration of leases;—4. The covenants to be inserted in them;—5. The form of the lease;—and, 6. General remarks on the stipulations to be entered into.

1. *Manner of settling a lease.*—When a lease is to be granted, the first rule which claims attention is, that the new lease should, if possible, be arranged two or three years before the expiration of the old one. Indeed, whether a new farmer is to be introduced, or the old one continued, this plan is equally advisable. It is another rule, that, on equal terms, the old tenant ought to be preferred, unless his conduct is particularly faulty. His management goes on regularly, and he must be a gainer, whilst the landlord profits, by warding off any attempt at exhausting crops, during the three or four last years of the lease. If an agreement cannot be entered into with him, the proper plan for a landlord to adopt is, to have the farm valued near the end of the lease, not perhaps by an entire stranger, but by the most intelligent and experienced person in the neighbourhood; nor ought a sum, beyond the one thus fixed upon, to be demanded. Let the farm be offered at that rent, for twenty, or any other number of years, first to the tenant in possession; and if he will not agree to the terms, let that offerer be preferred, *who will stipulate to make the greatest exertions for the improvement of the estate, and who will leave it in the best order at the end of his lease.* In this way, the interest of the farmer, the proprietor and his family, and the public, "are all combined."

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* See the Preface to Bell's valuable Treatise on Leases, 4th edit. ann. 1825.

2. *Period of entry, and regulations connected therewith.*—These are points which require no small degree of consideration; and instead of the various, discordant and complicated practices now in use *, which the County Reports have for the first time so fully disclosed, it would be advisable, that some plan were fixed upon, by which the time of entry should be adapted to the different kinds of farms, whether pasturing or tillage farms, and to the situation of the district in regard to fuel † and other circumstances.

It is for the interest of the landlord and of the public, that the term should always be made favourable *to the incoming tenant* ‡; otherwise he may be placed in a most disagreeable predicament for the first twelve, or even eighteen months after his entry §, may suffer materially in his interests, and may thence become dispirited, and relax his exertions.

The points to be considered, respecting this subject, are, when the entry should be: 1. In hill-pasture farms; 2. In low-lying grazing farms; 3. In arable farms; and, 4. Under what general regulations.

1. In *hill-pasture farms*, the incoming tenant wishes to get possession of the premises, at a time when he can purchase the sheep or cattle he requires, on the most reasonable terms, namely, immediately previous to the commencement of the grass season. Hence, in the more northern counties of England and in Scotland, about *Whitsuntide* is considered to be the most convenient term for that purpose.

2. In the southern districts of England, the usual time for changing the tenant of a grazing farm, is on the 29th day of September, about the close of the previous summer, or at the season when most of the great stock fairs are holden; and it is a time which is greatly to be preferred for that purpose. It is just before the commencement of the rainy

* For instance, in Gloucestershire, leases commence at Ladyday, and in that case, in the Vale. the going-off tenant holds a part of the grass-lands till old Mayday, and has likewise the going-off crop of wheat, with the use of the barns till the midsummer following. In this usage there is great inconvenience, especially when the new tenant is at variance with the old one, which is not uncommonly the case. Each has an opportunity of distressing and incommoding the other, in various ways.—*Gloucestershire Report*, p. 35.

† Where the fuel is peat, the entry is at Whitsunday, that the tenant may provide himself with that essential article during the summer, the only proper season for that purpose. *Forfarshire Report*, p. 251.—It has been suggested, that the entry might be made at Michaelmas, or Martinmas, even where the fuel is peat, if it were incumbent on the old tenant to provide the peat, and for the new one to pay the value of it.—*Remark by Mr Middleton*.

‡ Undoubtedly this ought to be the case, but in Bedfordshire, and various other counties, neglect on the part of the landlords and their agents, and overreaching conduct on the part of the outgoing tenants, have long ago introduced the contrary practice, in almost every instance; and tenants expecting and claiming *to quit as they entered*, there seems no other means of introducing improvements in this essential particular, but for the landlords specially to *stipulate* for a new mode of quitting, at the time of the next letting; unless, by allowing a compensation, the tenants can be brought to agree, during the present term, for a different quitting at the end of it, to the entry that commenced it. If the rule be general, the outgoing tenant, if he takes another farm, will be compensated for the loss he may sustain in the former one.

§ Aberdeenshire Report, p. 181.

season, and the only time which can prevent an outgoing tenant from doing considerable mischief to the land, by the poaching of cattle. It is likewise the most convenient season for the new tenant, not only to buy live stock, but to do various works, preparatory to the following summer. Indeed a successful summer occupation cannot be expected, unless the same tenant possesses the land during the previous winter. The like reasoning proves, that Michaelmas is the most suitable season for changing the tenant of the hay-farms in Middlesex *.

3. In arable farms, *Michaelmas* in the southern districts, and *Martinmas* in the more northern, are the most beneficial to both parties. The outgoing tenant remains till his crop is reaped, and secured from the risk of injury; whilst the incoming tenant enters, when his presence and stock are necessary, to sow his wheat and tares in the autumn, as well as to prepare the lands for the ensuing spring crops; and when he can generally purchase every article he wants, on moderate terms. Some inconvenience will arise, both to the incoming and outgoing tenant, whatever be the term of entry; but perhaps, on the whole, Michaelmas or Martinmas, for arable farms, is as little liable to objection, as any other that can be suggested; provided the fallow, and the turnip land are worked by the outgoing tenant, for which a fair compensation ought to be made to him.

It were much to be wished, that the subject were thoroughly investigated, and that some general rules were laid down by the most extensive proprietors in the several counties, for the commencement and termination of leases, according to the climate, mode of husbandry, and a variety of other circumstances of a local nature. If this could be effected, it would soon be considered *the custom of the country*, and as such would be enforced by law. This would ultimately prove highly advantageous both to landlords and tenants.

4. As to the general regulations connected with the change of tenants, one rule is, "That the possession of the farm should be entire, "and not partial." Great losses are sustained, where a contrary system is adopted; for it leads to endless disputes between the incoming and outgoing tenant, by which the interests of both are most seriously affected. Whatever portion of the crop the new tenant may want, should be valued, and paid for, at that valuation, by the new possessor. The outgoing tenant should also be paid for ploughings substantially done, as well as for such turnips as may be growing in the land, in a clean state, at the end of the lease; and for seeds left in the ground for a crop of clover, or herbage, to be obtained in the ensuing year. But on no account ought he to be permitted to remove any straw, hay, or manure, from the premises he has occupied. Were this prohibition made general, it would not be attended with inconvenience to any individual continuing a farmer.

3. *Duration of leases.*—This is a subject of great importance; for unless a tenant has the certainty of enjoying the land he occupies

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* Communication from John Middleton, Esq. The late Duke of Bedford, when letting his Bedfordshire estates, in 1795, changed the term to *New Michaelmas,* making compensations in all proper cases.

for a determined period, he can have no inducement to make any substantial improvement *. Tenants at will, from the very nature of their tenure, are almost precluded from the possibility of making improvements, whilst they have it in their power to ruin the land they occupy †. Such is the difference between a precarious and a certain tenure, that the same land, which, *at will*, is only worth 20s. per acre, is considered to be worth 40s. *with a lease of* 21 *years* ‡. It has been justly observed, that it is of little consequence whether a farmer is possessed of a capital, if, from want of security in his possession, he is afraid to lay it out: and if he has no capital, he cannot procure any assistance from others, to invest in improvements, however profitable they might be with this essential security §.

The periods for which leases are usually granted, are:—Short leases for 3, 5, or 7 years;—Moderate leases for 14, 19, or 21 years;—Long leases for 25, 31, or 57 years;—Leases for one life;—Leases for two or three lives;—and, Leases upon the payment of a fine.

1. Short leases are better than none, provided they extend to at least the number of years included in the course of cropping that may be adopted; and they may be less exceptionable, where a farm is in good condition and well cultivated; but under such leases, agriculture can never be carried to a high degree of perfection ‖. A tenant on a short lease, has no inducement to try experiments; and consequently, agriculture, on his farm, must remain for ever stationary. A man who has a considerable capital, and wishes to employ it in extensive farming, has a right to look for the comforts and conveniences of life, for himself and his family, *with some degree of certainty and independence;* and if he obtain no security for possessing them in the line of agriculture, under adequate leases, he will most assuredly renounce so unpromising a profession, and employ himself and his capital in some other pursuit. Leases of considerable duration, therefore, are most essential requisites, for promoting the interests of agriculture, *in all cases.*

2. Leases for about 20 years ¶, are greatly preferable to shorter

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* In particular cases, tenants *at will* do place such implicit confidence in the honour of a great family, distinguished by immense wealth, and hereditary virtues (for instance on the Devonshire estate), as to lay out to the amount of some thousands of pounds on single farms. *Derbyshire Report*, vol. ii. p. 36.—But such cases are rare, and many have suffered in other districts from misplaced confidence. See Cornwall Report, p. 22.

† Middlesex Report, p. 83.

‡ Oxfordshire Report, p. 2. In Norfolk, the difference of having a lease, is reckoned worth twenty per cent.—*Kent's Norfolk*, p. 124.

§ Derbyshire Report, vol. ii. p. 36, and vol. iii. p. 634.

‖ Marshall recommends leases for six years certain, with a condition, that if neither party gives notice to quit before the expiration of the first three years, the term be then prolonged for nine years, and so on from six years to six years, until three years' notice be given by either party. *On Landed Property*, p. 365.—This is much better than no lease, but still it does not furnish an adequate encouragement to expenditure and improvement.

¶ The exact number of years ought in some measure to depend upon the course of crops; for the tenant ought to have the advantage of at least three complete rotations.

terms, for all the parties concerned. Under the security of such a term, the tenant can afford to give more rent for his land; he can spend money on improvements, with the confidence of reaping the benefit of them; and, by the consequent increase of produce, his profits will be advanced in proportion to the sum he has expended,—considerations in which the interests of the landlord, the tenant, and the public, are all involved *. In general, unless where great improvements are necessary, a lease of about 20 years is perfectly sufficient for the security of the tenant; and it is a great advantage, both to him and to the landlord, that, at the end of such a period, the state of the farm should be examined, the improvements that have been made in it ascertained, and those that may still be executed, pointed out. Granting leases also, is greatly in favour of raising rents, and consequently of promoting industry to pay them. When there is no lease, there is little more reason for raising the rent at one period than another.

3. If a farm is almost in a state of nature, and requires inclosing, liming, draining, and other expensive improvements, a lease of 25 years may be sufficient; but if a considerable sum is to be expended for erecting or repairing a house and offices, a lease of at least 30 years may be necessary, to allow the improving farmer or his family a fair and adequate return for his expenditure. Perhaps there is no species of lease more advantageous to the agriculture of a country, than a long one given on a farm that requires extensive improvements. A spirited tenant, who improves such a farm, considering his risk, trouble, and expenses, is well entitled to more than mere remuneration or ordinary profit. In some cases, therefore, leases to the extent of even 50 or 60 years have been granted, and have produced great improvements in the cultivation of barren land. They are peculiarly beneficial both to the landlord and his family, when there are periodical rises of rent every ten or twelve years †. The security of a long lease gives scope to a variety of permanent improvements, and the rise of rent, in moderation, is a spur to exertion ‡.

4. Leases for a single life, are far from being favourable to improvement, though there is something benevolent in the idea, that a farmer is not to be removed during his life. When the exact length of a lease is fixed, the tenant makes his arrangements accordingly, and he lays out his capital early, in the expectation of having a greater return, before the termination of the lease, than if he were more dilatory in his exertions; but when the period depends upon his own life, he is apprehensive, that if he spends a large sum of money, the benefit of it may be lost to himself and his family, from the uncertainty of human existence. He lays out no part of his capital, therefore, but in the expectation of immediate returns, and as age advances, he becomes the

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* Kent Report, p. 48.

† Aberdeenshire Report, p. 90.

‡ Husbandry of Scotland, vol. ii. p. 212.—This goes upon the supposition, that the national currency will progressively depreciate; which is the case in its natural state.

more negligent and less inclined to exertion *. Indeed if a leaseholder for life become at any time an invalid, there is an end of all idea of improvement. He is necessarily tempted, seeing the precariousness of his life, to extract from the soil all that he can, whilst he has it in his power.

5. Leases for three lives, unless there be a rise of rent with each life, are deservedly reprobated. The occupier, secure in his possession, grows indolent, neglects the cultivation of his farm, thereby injures the community, and impairs the interest of his successor †. It has been remarked, that neither are the roads so well managed, nor is the land in such good condition, on farms leased on lives, as even where no lease whatever is granted ‡. Leases on lives were formerly given, to induce tenants to take farms, when little of the spirit of agricultural improvement existed §; but they are no longer necessary on that account.

6. Leases upon fines are likewise justly objected to. The sum paid down by way of fine, drains the tenant of his capital, and prevents him from improving his farm. Such leases also, partake too much of the nature of a lottery, and the calculations are too intricate for a common farmer ||. The frequent recurrence and magnitude of the fine, and the expenses attending it, are likewise extremely severe upon the tenant; and require a greater degree of economy and foresight, than is always to be met with, particularly in youth. If the fine were diminished, and the reserved rent increased, the interests of both parties would be consulted ¶. On the whole, leases on fines are found to be so extremely injurious, that landlords see the necessity of permitting such tenures to run out, and that mode of letting land, will soon in a great measure disappear **.

It is said, that in grazing farms, a long tenure is not so necessary; for as they require less labour and expense than arable farms, they may be occupied to advantage, even on a lease of very moderate duration. But even in such cases, it would be better to grant a term of 10, 15, or 21 years, with a rise of rent at certain periods, by which the tenant would not be compelled, continually to shift from place to place, and perhaps change his stock from time to time, by which his interests would be materially affected ††.

In arable farms, which are already much improved, and in a high state of cultivation, it is contended, that long leases are unnecessary, because it requires less labour and expense to crop them; and it is supposed, that in the course of ten or twelve years, the tenant may have an adequate return, and an ample profit on his capital expended.

* Husbandry of Scotland, vol. ii. p. 216.
† South Wales Report, vol. ii. p. 172.
‡ Shropshire Report, p. 136.
§ Stirlingshire Report, p. 101; Derbyshire Report, vol. ii. p. 35.
|| South Wales Report, vol. i. p. 171.
¶ Berkshire Report, p. 54; Oxfordshire Report, p. 40.
** Holt's Lancashire, p. 26.
†† General Report of Scotland, vol. iii. p. 378.

Yet as no lime, or other permanent manure, will be purchased, nor any expense laid out, during the last three years, those short leases are very exceptionable; for it is clear that such a farm, by shifting its tenant every ten or twelve years, in place of advancing in fertility, will be essentially injured. A short lease therefore, must be an obstacle to the progressive improvement of even such a farm: and it will never yield an adequate rent, nor reach the highest state of productiveness of which it is susceptible, while it continues to be held by such a precarious tenure *.

On the whole, experience has fully domonstrated, that short leases, and those whose duration is uncertain, are injurious to improvement; and that a period of 19 or 21 years, is a fair term, in an improving country, for all parties, as it secures to the proprietor the progressive improvement of his land, and a periodical addition to his income, while it rouses the energy of the industrious farmer, from the certainty of his reaping the profit of his labour, skill, and capital, in consequence of his having a certain interest in the soil he cultivates †. The successful practice and experience of Mr Coke of Norfolk, whose rent-roll, chiefly by the system of granting judicious leases, has been so much increased within the memory of man, has put this question beyond all doubt. A prejudice against the granting of leases, therefore, if not removed by the good sense of the landlords, will injure, beyond all calculation, not only the interests of the proprietors, but the agriculture of the kingdom ‡. The difference between a lease and no lease, and between a long and a short lease, affects almost every operation that takes place on a farm. Where a regular system of leasing does not exist, not only all improvements are neglected, but often a gradual deterioration of the land is the consequence §.

It must not be imagined, however, that leases ought to be indiscriminately given. They certainly ought not to be granted, but where a farm is of a proper size;—is put into a shape fit for profitable cultivation;—and where tenants can be found, possessed of skill, spirit, and capital, to carry on its cultivation. The improvement of an estate may be retarded, instead of being promoted, if leases are given of ill-arranged occupations, and to ignorant, slothful and needy farmers, not entitled to the confidence of their landlord. Nor ought they to be granted without proper covenants to protect that property from waste ||.

4. *Covenants.*—When a lease is granted, it is essentially necessary for the interest of the landlord, who is properly a trustee for his family and the public, that it should be under such covenants as may

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* General Report of Scotland, vol. iii. p. 379.

† Middlesex Report, p. 79. It has been well remarked, that if a lease is granted for a long term of years, the farmer *is apt to procrastinate commencing his improvements*, having, he thinks, abundant time before him; whereas, with a lease of a medium duration, if the land is of a good description, he endeavours to get his farm into perfect order, *as fast as possible*, that he may be able to get an adequate return for the money he lays out, before his lease terminates.

‡ Hertfordshire Report, p. 34.

§ Young's Essex Report. vol. i. p. 28.

|| Husbandry of Scotland, vol. i. p. 215.

prevent the property from being injured, during the term agreed upon; more especially when the lease approaches to its termination, and the tenant has no peculiar inducement to prosecute his improvements, or to preserve the fertility of the soil. The necessity of such covenants, to prevent waste, is proved by innumerable examples. The fields are otherwise cropped till they can yield no more; the farm is reduced to half its value, and can only be recovered through the means of an enriching, but expensive system, either by the proprietor taking the farm for some years into his own hand, or letting it for less rent than what it would have produced under more careful management *. In general, however, the covenants in leases are too numerous and too complicated. Unnecessary restrictions are a great impediment to improvements, by precluding that spirit of enterprise and experiment, which has proved the principal source of new discoveries, and of prosperous agriculture. At the same time, where there are no stipulations for preserving the farm in good order at the termination of the lease, more especially in regard to the quantity of grass land;—the extent and cultivation of the land in fallow;—the manure to be left for the incoming tenant;—and the state of repair in which the houses and fences ought to be given up;—the farm is left in poverty and wretchedness, as has often happened to negligent landlords †, or those who have not active and diligent land stewards, to see that the covenants in the leaves are strictly complied with. The over-cropping of the land, towards the expiration of a lease, is sometimes called, *getting the land in readiness for the landlord* ‡. It has been well observed, that if a tenant deteriorates the property entrusted to him, instead of paying a share of the produce, he deprives the landlord and his family of part of their capital. Hence tenants, like kings, as Lord Kames remarks, ought to be fettered; but not so fettered, as to bar improvement, nor left at liberty to do mischief §.

If men were uniformly distinguished by knowledge and integrity, covenants would not be necessary. It is impossible, however, for any prudent landlord, to place unbounded confidence in a person, who has an interest in doing him a most essential injury; since, the more he exhausts the estate, the more he may ultimately enrich himself. Such attempts at exhaustion will be made, though they have often proved as injurious to the tenant, as to the landlord. Hence it is advisable for a landlord to insist on security for the safety, and in some cases, for the improvement of his property, though, in order to obtain that security, he must be content to accept of less rent than otherwise he might receive. Covenants are, in fact, a species of rent; and though they may, for a time, diminish the annual income, yet, if judiciously formed, and clearly expressed, they will prevent the deterioration of an estate, and in that manner add to its permanent value. The true nature of a lease, under proper covenants, is an agreement, by which the proprietor accepts of a fair rent, or even rather less than the land might

* Middlesex Report. p. 40.
† Husbandry of Scotland, vol. i. p. 215.
‡ Cheshire Report, p. 111.
§ Gentleman Farmer, p. 412.

pay; while the tenant is furnished with sufficient inducement to increase the value of the farm he occupies, and will thus be enabled to afford even a higher rent when the lease terminates. Instead of a mercenary contract, therefore, a connexion, for the mutual advantage of both parties, may thus be formed; which, if the tenant fulfils the expectations that are entertained of his exertions, is likely to be continued. In short, that great object, both for the public, and for the proprietor and his family, "*the progressive improvement of an estate,*" ought not to be sacrificed, for the hazardous experiment of obtaining a temporary advantage, at the risk of future injury.

5. *Form of a lease.*—Leases are too often drawn up by men ignorant of agriculture, and hence are made replete with obsolete covenants, which shackle the tenant unnecessarily, injure the landlord, and occasion incalculable losses to the community *.

The covenants in a lease must necessarily vary, according to circumstances. It is desirable, however, to have a form laid down, distinct and simple, instead of being both complicated and confused. For that purpose, after the necessary preamble, stating the parties contracting,—the situation of the property leased,—the extent of the farm, (a plan of which ought to be subscribed by the contracting parties),—the duration of the lease,—and the time of entry; it is then proper to enumerate, 1. The powers and privileges reserved to the landlord;—2. The obligations incumbent on the tenant;—and 3. The stipulations obligatory upon both. Leases thus drawn up, would not be liable to much uncertainty or dispute; and if any should occur, it is expedient, that a mutual obligation for settling the same by arbiters, should be inserted in the lease itself.

6. *General remarks on leases.*—When a new lease is to be entered into, the farm to which it relates should be inspected by an intelligent agriculturist, who should point out, what draining, fencing, buildings, roads, &c. are necessary, what part of them ought to be executed by the proprietor, and what by the tenant. The inspector should, at the same time, fix on a plan of management suited to that particular farm, point out the waste or inferior land to be reclaimed or improved, also how and when such operations are to proceed, and in what condition the lands are to be kept and left. These points being fixed, the terms should be distinctly expressed in the lease or covenant, so that parties might know the rights they had to claim, and the duties incumbent on them, respecting that individual farm.

In the management of a large estate, nothing can be more absurd than to frame leases on a uniform plan, to be applied to land of every diversity of soil, altitude, and state of improvement. Yet, on some large estates, the leases are all formed on one model, and in some instances they have been printed, ready to be filled up like militia schedules, or policies of insurance. Under such arrangements, the leases of store-farms, and grain-farms, those in high cultivation, and such as

* Middlesex Report, p. 84.—In the General Report of Scotland, vol. iv. p. 324, the subject of covenants is more fully discussed.

are nearly in a state of waste, contain the same rules of husbandry, with great injury to the occupier, and frequently leading to litigation.

In some leases a plan of management is inserted; but many consider it more advisable, where the tenant is a person of skill, character, and capital, to leave this to his judgment, and to bind him down to those regulations only, which may secure the landlord against any danger from the land being exhausted, at the termination of the lease; which is effectually secured, by enforcing an alternate white-strawed and green or pulse crop.

It is sometimes agreed, that the outgoing tenant shall be entitled to the stable-yard manure made during the winter preceding the last crop he grows, for which the incoming tenant shall be bound to pay a fair value.

Again, the straw of the last crop is sometimes given to the incoming tenant, in return for the expense and trouble of cutting down the crop.

Michaelmas is less expensive, and greatly more convenient to the incoming tenant, than any other of the four quarters, for entering on a farm, and it is not any disadvantage to the outgoing one; for which reason farms let more readily at that season than any other, which is such an object to the landlord, as should induce him, to prefer having his leases determined at that time.

No. IV.

OF FARMING ACCOUNTS.

The keeping of regular accounts, has been found fully as advantageous in farming, as in other business; and hence forms have been devised, for recording agricultural, with as much accuracy as commercial transactions. Such regular statements are strongly recommended to the attention of those who carry on the business of farming, to any great extent. Minute attention, however, cannot be expected from the generality of occupiers, though every farmer, who is anxious to succeed in his profession, will at least resolve, annually to prepare regular accounts of the produce, expenses, and profit, derived from his farm. As a model for such statements, the following account is given, of a farm consisting of 553 Scotch, or 691 English acres, drawn up by the late George Rennie, Esq. of Phantassie, who was justly considered at the head of the farmers of East Lothian.

Before detailing the particulars, it is proper to state, that as the farm contained different soils, a part of it was managed according to the four-course, and the remainder according to a six-course plan.

The first part, which consisted of about 252 Scotch acres, was cultivated in the following manner: 1. Fallow;—2. Wheat;—3. Clover and rye-grass, either soiled, or converted into hay;—4. Oats;—5. Beans, drilled and horse-hoed, but partly tares *;—and 6. Wheat.

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* Five acres were annually sown with tares, of the field destined for beans.

The second part consisted of about 248 Scotch acres, and was cropped as follows: 1. Turnips;—2. Thirty-one acres winter wheat sown in spring, and 31 acres of barley;—3. Clover and ryegrass, generally pastured;—and 4. Oats.

Besides the above, there were about 53 acres kept in perennial pasture, which was broken up when occasion required. The above was the general system of management adopted upon this farm, though at particular times, it might be partially departed from, according to seasons and circumstances.

An extensive distillery being carried on upon Mr Rennie's property, a considerable quantity of dung was thence procured. The benefit derived from this source, was no doubt of great importance: a charge therefore, for the increased quantity of manure obtained by means of distillery materials, is included in the charges against the farm.

GENERAL STATEMENTS OF PRODUCE, EXPENSES AND PROFIT.

I. *Table of Produce.*

1st, *On Clay Soils, arranged according to the Six-Course.*

1. 42 acres fallow.			
2. 42 acres of wheat after fallow, at 10 bolls, is 420 bolls, at 40s. per boll, ...	L.840	0	0
3. 42 acres of clover and rye-grass made into hay, 200 stones per acre, is 8400 stones at 10d.	350	0	0
4. 42 acres oats, 10 bolls, is 420 bolls, at 25s. .	525	0	0
5. 42 acres beans, 8 bolls, is 336 bolls, at 24s. (including 5 acres tares *), . . .	403	4	0
6. 42 acres wheat, 8 bolls per acre, is 336 bolls, at 40s.	672	0	0
252	L.2790	4	0

2dly, *On Light Soils, managed according to the Four-Course Shift.*

1. 62 acres turnips, at L.10, . .	L.620	0	0
2. 31 acres winter wheat, sown in spring, at 8 bolls, is 248 bolls, at 40s. . .	496	0	0
31 acres barley, at 10 bolls, is 310 bolls, at 30s.	465	0	0
3. 62 acres of clover and rye grass pastured, at L.7,	434	0	0
4. 62 acres oats, at 10 bolls, is 620 bolls, at 25s.	775	0	0
248	L.2790	0	0

Value of 53 acres kept in perennial pasture, at L.4 per acre, ...	L.212	0	0

* Though the tares were soiled, it was thought best to state their value the same as the beans.

Abstract.

	L.	s.	d.
Value of produce raised on the clay soils, .	L.2790	4	0
Ditto of ditto raised on the light soils, . .	2790	0	0
Ditto of perennial pasture, . . .	212	0	0
Total value of produce,	L.5792	4	0

II. *Tables of Expenses, Rent, &c.*

Seed for Six-Course Shift.

	L.	s.	d.
1. Wheat for 42 acres, at 5 firlots; $31\frac{1}{2}$ bolls, at 40s.	L.63	0	0
2. Clover and rye-grass for 42 acres, at 20s. .	42	0	0
3. Oats for 42 acres, at 14 pecks per acre, is $36\frac{3}{4}$ bolls, at 25s. . . .	45	18	9
4. Beans for 42 acres, at 14 pecks per acre, is 49 bolls 14 pecks, at 24s. *	59	17	0
5. Wheat for 42 acres, at one boll, is 42 bolls, at 40s.	84	0	0

Seed for Four-Course Shift.

	L.	s.	d.
1. For turnips, 62 acres, at 2 lb. . .	6	4	0
2. Wheat, 31 acres, at 1 boll, is 31 bolls, at 40s.	62	0	0
Barley, 31 acres, at 9 pecks, is 17 bolls 7 pecks, at 30s. . . .	26	4	2
3. Clover and rye-grass seed, 62 acres, at 20s. .	62	0	0
4. Oats, 62 acres, at 14 pecks, is $54\frac{1}{4}$ bolls, at 25s.	67	16	3
Value of seed,	L.519	0	2

Value of Hay and Corn consumed by Horses.

	L.	s.	d.
1. Hay, 2000 Scots stones, at 10d. . .	L.83	6	8
2. Corn, 350 bolls, at 25s. . .	437	10	0
3. Clover and rye-grass used in sowing 10 acres, at L.8,	80	0	0
4. Tares, 5 acres, at L.8, . . .	40	0	0
	L.640	16	8

Expenses of Labour.

	L.	s.	d.
1. Overseer, . . .	L.50	0	0
2. 15 men servants, at L.35 per annum, .	525	0	0
3. 2 labourers and a boy, . .	70	0	0
4. Cleaning turnips, ...	50	0	0
5. Harvest work, besides what is furnished by servants on the farm, . . .	220	0	0
6. Threshing, cleaning, and marketing, .	80	0	0
7. Smith, carpenter, and saddler, . .	100	0	0
8. Incidents, ...	30	0	0
	L.1125	0	0

* The seed tares for an acre are charged at the same price as beans, it being well known that a much smaller quantity of tares is required for seeding the ground, than of beans.

Various Articles.

1. Rent 553 acres, at L.4 per Scotch, or L.3, 4s. per English acre, . . .	L.2212	0	0
2. Assessed taxes and statute labour, .	50	0	0
3. Dung from distillery, . . .	200	0	0
N. B. The original materials furnished by the farm are supposed to be increased in value, to the above amount, by being manufactured at the distillery.			
4. Interest on capital stock, (say L.6000,) .	300	0	0
5. Tear and wear of perishable stock, .	100	0	0
	L.2862	0	0

Abstract of the above Tables, No. II.

Value of seed, . . .	L.519	0	2
Value of horse corn, &c. . . .	640	16	8
—— of servants' labour, . . .	1125	0	0
Various articles, such as rent, &c. . .	2862	0	0
	L.5146	16	10

The Result.

Value of produce, . . .	L.5792	4	0
Various expenses, . . .	5146	16	10
Net profit,	L.645	7	2

The net profit seems to be L.1 : 5 : $1\frac{1}{4}$ per Scotch acre, (or L.1 : 0 : 1 per English acre), which is a trifle more than eleven and a-half per cent. upon the capital stock, besides the legal interest), supposing that stock to amount to L.6000.

No. V.

PROOFS OF THE UNFAVOURABLE IDEA ENTERTAINED BY BRITISH STATESMEN, OF THE ABILITY OF THIS COUNTRY TO RAISE A SUFFICIENCY OF GRAIN FOR ITS OWN CONSUMPTION, AND OF THE LITTLE IMPORTANCE ATTACHED BY THEM TO AGRICULTURE, PREVIOUS TO THE ESTABLISHMENT OF A NATIONAL INSTITUTION FOR PROMOTING ITS IMPROVEMENT.

In the year 1790, the Committee of Privy Council appointed to inquire into all matters relating to trade, took into its consideration the laws regarding the exportation and importation of grain, and presented a Report to his Majesty upon the subject, which is drawn up with much ability, although with such little idea of the *agricultural resources of the country*, that we are told, we must depend for a part of our consumption, not on an increased cultivation at home, nor even on the produce of Europe, but on the harvests of America. Yet in the year 1808, as appears from the Custom-house accounts, we exported corn to the value of L.470,431, and imported only to the amount of L.336,460, consequently Great Britain became again an exporting country, and for that year at least, with the assistance of Ireland, was independent of foreign nations for corn.

In the year 1791-2, Mr Pitt explained, in a speech on the state of the nation, what appeared to him the causes of the general increase of the national prosperity which had taken place at that time. That speech is very ably commented upon by Mr Arthur Young, in his Annals of Agriculture *. Mr Young was shocked to find, in that speech, the greatest, dearest, and most important interests of the kingdom, totally and contemptuously overlooked, as of no sort of consequence in the great scale of national prosperity. A financier, he observes, in giving a general view of the national resources, and dwelling with pride on the public revenue, does not think that agriculture, which, even then paid twelve millions sterling *per annum*, in public burdens, worthy even of being named amongst the sources of prosperity!

Mr Young also remarks, "that the agricultural interests of this kingdom, perhaps never found themselves placed in so contemptible a position, as in this speech of the Minister, who, wishing to make the utmost parade of every circumstance that would count in a catalogue of national advantages, totally overlooks every thing connected with land." Mr Young little expected, in the course of a few months, to be Secretary to a Board of Agriculture, established with the concurrence of the very Minister, by whom that speech had been delivered.

As late as the year 1796, another British statesman, distinguished

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* Vol. xvii. p. 369.

for political information, (Lord Auckland), delivered a speech in the House of Lords, which was afterwards published, and of which the following is an extract:

"To what, under the protection and favour of Divine Providence, shall such prosperity be ascribed?—to our naval superiority and successes; to our conquests in the East and West Indies; to the acquisition of new markets; to the enterprising spirit of our merchants; to the improvements of our manufacturers; to the energy of our countrymen in arts and in arms; to the union of liberty with law; to the national character, cherished by, and cherishing the principles of our inestimable constitution; that constitution which it has been the object of our enemies to destroy, by means and effects utterly destructive to themselves; that constitution, which it is the great purpose of our struggles, in this just and necessary war, to preserve and to maintain *."

Not one word of agriculture in this whole paragraph, intended to enumerate the causes to which our prosperity was to be ascribed. We have hitherto indeed been too much considered as a mere commercial nation; whereas every country possessed of an extensive and fertile territory, ought to account the cultivation of its soil, as the surest foundation of its prosperity, and the best entitled, of all the sources of that prosperity, to the peculiar attention of an enlightened government. Such a government will be ready, at all times, to remove every obstacle to improvement; if not to promote, by public encouragement, those unceasing exertions, by which alone, the whole territory of a great country, can be rendered, what it ought to be—one uninterrupted scene of industry and cultivation.

No. VI.

EVIDENCE OF THE GREAT ADVANTAGES DERIVED FROM THE ESTABLISHMENT OF A BOARD OF AGRICULTURE, FROM AN ACCOUNT OF THE BILLS OF ENCLOSURE PASSED IN THE COURSE OF FORTY YEARS, IN TWO PERIODS, OF TWENTY YEARS EACH, NAMELY, FROM 1774 TO 1793, PRIOR, AND FROM 1794 TO 1813 INCLUSIVE, POSTERIOR TO, THE ESTABLISHMENT OF THE BOARD OF AGRICULTURE.

1st Series. Years.			No. of Bills.	2d Series. Years.			No. of Bills.
1774	-	-	59	1794	-	-	73
1775	-	-	33	1795	-	-	76
1776	-	-	55	1796	-	-	70

* See the substance of Lord Auckland's Speech in the House of Lords, the 2d day of May 1796. London: printed for J. Walter, Charing-Cross.

Table continued.

1st Series. Years.			No of Bills.	2d Series. Years.			No. of Bills.
1777	-	-	88	1797	-	-	86
1778	-	-	61	1798	-	-	52
1779	-	-	66	1799	-	-	65
1780	-	-	35	1800	-	-	82
1781	-	-	22	1801	-	-	49
1782	-	-	17	1802	-	-	158
1783	-	-	13	1803	-	-	92
1784	-	-	12	1804	-	-	52
1785	-	-	22	1805	-	-	68
1786	-	-	25	1806	-	-	76
1787	-	-	21	1807	-	-	91
1788	-	-	34	1808	-	-	92
1789	-	-	31	1809	-	-	122
1790	-	-	23	1810	-	-	107
1791	-	-	34	1811	-	-	133
1792	-	-	35	1812	-	-	156
1793	-	-	58	1813	-	-	183
			749				1,883
Average,		-	37	Average,		-	94

There cannot be stronger evidence, of the advantages derived from the establishment of a Board of Agriculture; nor a better proof of a general spirit of improvement, having been thereby excited, than what this table furnishes. The *extra* bills of enclosure, in the 2d Series, amounted to 1134; and as each bill, on an average, would promote the improvement of at least 2000 acres, hence 2,268,000 acres in all, must have been thus improved, in England alone, in these twenty years, chiefly owing to the spirit of improvement excited by the exertions of that establishment.

The Board of Agriculture was continued for some years longer; but towards the end of its existence, its affairs were not conducted with that spirit with which it was originally animated. The following table proves the fatal effects of its extinction, which took place in 1821.

Years.			No. of Bills of Enclosure.	Years.			No. of Bills of Enclosure.
1814	-	-	116	1823	-	-	12
1815	-	-	79	1824	-	-	19
1816	-	-	45	1825	-	-	21
1817	-	-	32	1826	-	-	20
1818	-	-	41	1827	-	-	22
1819	-	-	43	1828	-	-	10
1820	-	-	39	1829	-	-	24
1821	-	-	35	1830	-	-	21
1822	-	-	14	1831	-	-	10

What a melancholy falling off, from 183 acts of inclosure in 1813, to 10 in 1831!

No. VII.

DESCRIPTION OF THE MODE OF MAKING NATURAL GRASS INTO HAY, AS PRACTISED IN THE NEIGHBOURHOOD OF LONDON.

By John Middleton, Esq. Author of the celebrated Report of Middlesex.

THIS branch of the rural art has, by the farmers of Middlesex, been brought to a degree of perfection, altogether unequalled by any other part of the kingdom. The neat husbandry, and superior skill and management, that are so much and justly admired in the *arable* farmers of the best cultivated districts, may, with equal justice and propriety, be said to belong, in a very eminent degree, to the *hay* farmers of Middlesex; for by them, may very fairly be claimed the merit of having reduced the art of making good hay to a regular system, which, after having stood the test of long practice and experience, is found to be attended with the most desirable success. Even in the most unfavourable weather, the hay made according to the Middlesex manner, is superior to that made by any other method, under similar circumstances. It is to be regretted, that this very excellent practice has not yet, except in a very few instances, travelled beyond the borders of the county. But as it most justly deserves the attention and imitation of farmers in other districts, I shall, for their information, endeavour minutely to describe the method in which the Middlesex farmers make their hay.

In order that the subject may be more clearly understood, I shall relate the particular operations of each day, during the whole process, from the moment in which the mower first applies his scythe, to that in which the hay is secured either in the barn or in the stack. Before I enter more immediately on this task, I would just premise a few observations. When the grass is nearly fit for mowing, the Middlesex farmer endeavours to select the best mowers, in number proportioned to the quantity of his grass, and the length of time it would be advisable to have it in hand; which having done, he lets it out, either as piece-work, or to be mown by the acre *.

About the same time he provides five hay-makers, (men and women †,) to each mower. These last are paid by the day, the men attending from six till six; but the women only from eight till six. For

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* Each man mows from one acre and a half to an acre and three quarters per day; some there are, who do two acres per day, during the whole season.—*J. M.*

† Including loaders, pitchers, stackers, and all others.—*J. M.*

an extra hour or so in the evening, when the business requires dispatch, they receive a proportionate allowance.

The mowers usually begin their work at three, four, or five o'clock in the morning, and continue to labour till seven or eight at night; resting an hour or two in the middle of the day.

Every hay-maker is expected to come provided with a fork and a rake of his own; nevertheless, when the grass is ready, and labourers scarce, the farmer is frequently obliged to provide both, but for the most part, only the rake.

Every part of the operation is carried on with forks, except clearing the ground, which is done with rakes; and loading the carts, which is done by hand *.

Having premised so much, I now come to the description of the business of the

First day.—All the grass mown *before* nine o'clock in the morning is tedded, in which great care is taken, thoroughly to loosen every lump, and to strew it evenly over all the ground †. Soon afterwards it is turned, with the same degree of care and attention; and if, from the number of hands, they are able to turn the whole again, they do so, or at least as much of it as they can, till twelve or one o'clock, at which time they dine. The first thing to be done after dinner, is to rake the grass into what are called *single* windrows ‡; and the last operation of this day is to put it into grass cocks.

Second day.—The business of this day commences with tedding all the grass that was mown the first day *after* nine o'clock, and all that was mown this day *before* nine o'clock. Next, the grass cocks are to be well shaken out into staddles (or separate plats) of five or six yards diameter. If the crop should be so thin and light, as to leave the spaces between these staddles rather large, such spaces must be immediately raked clean, and the rakings mixed with the other hay, in order to its all drying of a uniform colour. The next business is to turn the staddles, and after that, to turn the grass that was tedded in the first part of the morning, once or twice, in the manner described for the first day. This should all be done before twelve or

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* In Scotland, the haymakers ted out the hay by the hand, and execute the greater part of the work, *without forks*, using them solely for loading the hay on the carts.

† The following observations on the Middlesex method of hay-making, were obligingly communicated by the late Thomas Skip Dyot Bucknall, Esq. M. P.

"By a regular method of tedding grass for hay, the hay will be of a more valuable quality, heats more equally in the stack, consequently is not so liable to damage, or fire; will be of greater quantity, when cut into trusses, and will sell at a better price; for when the grass is suffered to lay a day or two before it is tedded out of the swath, the upper surface is dried by the sun and winds, and the interior part is not dried, but withered, so that the herbs lose much, both as to quality and quantity, which are very material circumstances, at the price hay now fetches at market. An instance in point: the physic gardeners who attend to their business, are very careful in the proper and equally drying their herbs, and they find their account in it."

‡ That is, they all rake in such a manner, as that each person makes a row, the rows being three or four feet apart.—*J. M.*

one o'clock, so that the whole may lie to dry while the work-people are at dinner. After dinner, the first thing to be done is, to rake the staddles into *double* windrows *; next, to rake the grass into *single* windrows; then the double windrows are put into bastard-cocks; and lastly, the single windrows are put into grass-cocks. This completes the work of the second day.

Third Day.—The grass mown and not spread on the second day, and also that mown in the early part of this day, is first to be tedded in the morning; and then the grass-cocks are to be spread into staddles, as before, and the bastard-cocks into staddles of less extent. These lesser staddles, though last spread, are first turned, then those which were in grass-cocks; and next the grass is turned once or twice before twelve or one o'clock, when the people go to dinner as usual. If the weather has proved sunny and fine, the hay which was last night in bastard-cocks, will this afternoon be in a proper state to be carried †; but if the weather should, on the contrary, have been cool and cloudy, no part of it probably will be fit to carry. In that case the first thing set about after dinner, is to rake that which was in grass-cocks last night into double windrows; then the grass which was this morning spread from the swaths, into single windrows. After this, the hay which was last night in bastard-cocks, is made up into full-sized cocks, and care taken to rake the hay up clean, and also to put the rakings upon the top of each cock. Next, the double windrows are put into bastard-cocks, and the single windrows into grass-cocks, as on the preceding days.

Fourth Day.—On this day the great cocks, just mentioned, are usually carried before dinner. The other operations of the day are such, and in the same order, as before described, and are continued daily, until the hay harvest is completed.

In the course of hay-making, the grass should, as much as possible, be protected both day and night, against rain and dew, by cocking. Care should also be taken to proportion the number of hay-makers to that of the mowers, so that there may not be more grass in hand at any one time, than can be managed according to the foregoing process. This proportion is about twenty hay-makers, (of which number twelve may be women,) to four mowers: the latter are sometimes taken half a day to assist the former. But in hot, windy, or very drying weather, a greater proportion of hay-makers will be required, than when the weather is cloudy and cool.

It is particularly necessary to guard against spreading more hay than the number of hands can get into cock the same day, or before rain. In showery and uncertain weather, the grass may sometimes be suffered to lie three, four, or even five days, in swath. But before it

* In doing which, every two persons rake the hay in opposite directions, or towards each other, and by that means form a row between them of double the size of a single windrow. These double windrows are about six or eight feet distant from each other.—*J. M.*

† It seldom happens, in dry weather, but that it may be carried on the third day.—*J. M.*

has lain long enough for the under side of the swath to become yellow, (which, were it suffered to lie long, would be the case), particular care should be taken to turn the swaths with the heads of the rakes. In this state, it will cure so much in about two days, as only to require being tedded a few hours, when the weather is fine, previous to its being put together and carried. In this manner, hay may be made and put into the stack at a small expense, and of a moderately good colour; but the tops and bottoms of the grass are insufficiently separated by it.

There are no hay-stacks more neatly formed, nor better secured, than those made in Middlesex. At every vacant time, while the stack is carrying up, the men are employed in pulling it, with their hands, into a proper shape; and, about a week after it is finished, the whole roof is properly thatched, and then secured from receiving any damage from the wind, by means of a straw rope, extended along the eaves, up the ends, and on each side of the ridge. The ends of the thatch are afterwards cut evenly below the eaves of the stack, just of sufficient length for the rain-water to drip quite clear of the hay. When the stack happens to be placed in a situation which may be suspected of being too damp in the winter, a trench, of about six or eight inches deep, is dug round, and nearly close to it, which serves to convey all the water from the spot, and renders it perfectly dry and secure.

It is of great advantage to the farmer, to give constant personal attendance on every party, directing each operation during the whole hay-harvest. The man who would cure his hay in the best manner, and at a moderate expense, must not only urge the persons who make the hay, the men who load the waggons, and those who make the stack, but he should be on the alert, to contrive and point out the manner in which every person may do his labour to the most advantage. Unless he does this, one moiety of the people in his hay-field will be of no material use to him; and if he should be absent for an hour or more, little or nothing will then be done. The farmers of Middlesex engage many hay-makers. Some of them have been known to employ two or three hundred: such men find it necessary to be on horseback, and the work-people find them sufficient employment. A man of energy will make the most of every hour, and secure his hay while the sun shines: one of an opposite description, lounges his time away, and suffers his hay to be caught in the rain, by which it is frequently half spoiled. Or if the latter should have the good fortune of a continuance of dry weather, his hay will be a week longer in the field than his neighbour's, and the sap of it dried up by the sun.

It is supposed that 400 lb. of grass, on being dried into hay, wastes to 100 lb. by the time it is laid on the stack; it is then further reduced, by heat and evaporation, in about a month, to perhaps 95; and between that and 90 I apprehend it continues through the winter. From the middle of March till September, the operations of trussing and marketing, expose it so much to the sun and wind, as to render it considerably lighter, probably 80: that is, hay which would weigh 90 the instant it is separated from the stack, would waste to 80, (in trussing, exposure on the road, and at market for about 24 hours), by the time it is usually delivered to a purchaser. During the following winter, the waste will be little or nothing: it is nearly obvious, that the same hay will weigh on delivery 80 in summer, and 90 in winter. From this circumstance, and others which relate to price, a farmer may determine what season of the year is the most advisable for him to sell his hay. I have known a gentleman have the hay of five years by him at one time; the price then rose, and he sold it to much advantage; and I now know, there are several farmers in this county, who have from one to two thousand tons of hay.

In the neighbourhood of Harrow, Hendon, and Finchley, there are many hay-barns capable of holding from 30 to 50, and some even 100 loads of hay. They are found to be extremely useful and convenient during a catching and unsettled hay harvest, as a safe receptacle for the hay as fast as it becomes dry. In the very common case of approaching rain, when the hay is fit for carrying, every nerve is, or ought to be, exerted, to secure it as much as possible; and that is most effectually done, by getting all the carts and waggons loaded with it, and drawn into the barns: the rest of the hay must take its chance in large cocks. These barns are also of considerable utility for the reception of loaded carriages daily, a short time before night, where they are secure, and afford certain employment for the men the next morning, before breakfast, in unloading. Even in dull or damp mornings, the hay can be safely unloaded under the cover of these buildings, when it could not be done on to a stack in an exposed yard. I remember a morning of this kind which threatened rain, in which my neighbours durst not uncover their stacks, when, under the security of a hay-barn, I unloaded twelve carts and waggons before the men went to breakfast: the day turned out fine, and my people were all ready for the hay field, where they re-loaded the carriages into the same barns before night.

In winter, and in all wet and windy weather, the barns afford safety to the broken cuts, and an opportunity of cutting, weighing, and binding hay; none of which operations could, at such a time, be performed out of doors. The farmers whom I have consulted on this subject, agree that hay may be put together earlier, even by a day, in a barn, than it would be safe to do in a stack.

The expense of a hay-barn is L. 100; but it generally saves, in straw and thatching, and in other advantages, the whole of its cost in three years. Indeed, I built one on oak posts, in the most complete manner, which holds 100 loads of hay, and am certain its savings equalled its cost in two years; but in this it was aided by the then high price of straw.

In the driest seasons, barns are a saving of 6s. or more *per* acre; and in wet seasons, the ready assistance which they afford in speedily securing the hay, has been known to make a difference in price of 20s. *per* load, on a small number of loads.

Close barns exclude the current of external air, which is, probably, the immediate cause of the ignition of the hot vapour, at the instant of its escape from the hay-stack. In the barn, this hot vapour, or steam, is confined in the empty space between the hay and the roof, until it has parted with so much heat, as to be incapable of taking fire, when it comes in contact with the external air, in its escape from the barn *.

No. VIII.

ON THE IMPROVED SYSTEM OF SUMMER FALLOW, AS PRACTISED IN THE LOTHIANS, AND ON THE ADVANTAGES OF THE GRUBBER.

By Mr Robert Hope, an experienced Farmer at Fenton, in East-Lothian.

NOTWITHSTANDING the objections which have been urged to the practice of occasionally summer fallowing land, yet its advantages, *on clay soils*, are now so well understood, and so universally admitted, by the most intelligent farmers in Scotland, as absolutely necessary for the profitable occupation of strong wet soils in that country, and in similar climates, that it becomes a matter of the greatest importance, to ascertain the most economical, as well as the most effectual mode of conducting that important operation :—important, in so far as it is well known, that in proportion to the judgment and accuracy with which it is performed, the success and value of all the various crops, throughout the succeeding rotation, necessarily depend.

In those districts in Scotland where summer fallowing is carefully executed, the ground intended for that process, is ploughed in the winter, as early as may be convenient, when the ridges generally are, and ought always to be, gathered up; by which means, the whole furrows are laid completely open, and the field, after the cross furrows (*grips*, or *gaw* furrows), are cleared out with the spade, is left drier during the winter, than it could possibly be by any other mode of ploughing. The next step is, to give the ground a second ploughing, immediately after the spring crops are sown, (it being understood, that the ground is thoroughly dry at the time), and the ridges ought then to be cloven down. The third ploughing, with a deep furrow, is to be given directly across the ridges, by which the soil is so far broken, as to be susceptible of being effectually operated upon by the harrows, which, with the roller, are then vigorously applied, till the soil is so far reduced, as to allow every root-weed upon the surface to be picked off by the hand. After this, that valuable implement the *grubber*, or scarifier, is used with the greatest advantage, as an assistant to the plough, in facilitating the thorough cleaning of

* In Scotland, shades, raised on pillars, and roofed with tiles, are preferred to barns, with stone or brick walls.

the soil; for by passing it once, twice, or even thrice, over the field, in proportion as root-weeds are abundant, taking care, at the same time, to give a slight harrowing, and attentively to pick up every root-weed that appears, every time that the grubber has gone over the field; the soil, to the depth of from four to six inches, will be completely cleared of every weed that was within reach of the coulters of the implement. The land is then ploughed a fourth time, when the ridges are once more gathered up; after which the harrows are applied, and the roller, if necessary, till the soil is again rendered fine enough to part with the root-weeds. When these are carefully picked off, the grubber is used as formerly, and the soil is soon made perfectly clean of every weed that may have infested it. Dung, lime, or compost, may then be applied with propriety, where necessary.

The expense attending this operation must depend upon various circumstances—as the nature of the soil, whether it be stiff, or tolerably free; whether the ground be in a medium condition, or very much exhausted; or whether the weather be wet or very dry; all of which make a great difference in the charges necessary. It is impossible therefore, to give a statement which will correspond exactly with every individual case or situation. The following estimate is given, as applicable to a moderately stiff soil, in tolerable condition, with nothing uncommon in the state of the weather; it being understood, that when these circumstances are materially altered, the expenses must likewise vary in proportion.

Average Expense of Summer Fallowing an English Acre of strong Clayey Soil.

The three first ploughings, 10s. each,	£.1	10	0
Two double harrowings,	0	3	4
Rolling,	0	2	0
Two double harrowings,	0	2	6
Hand-picking weeds,	0	1	6
Grubbing,	0	3	6
One double harrowing,	0	1	3
Hand-picking weeds,	0	1	0
Fourth ploughing,	0	8	0
One double harrowing,	0	1	3
Rolling,	0	1	8
One double harrowing,	0	1	3
Hand-picking weeds,	0	0	9
Grubbing,	0	3	0
One double harrowing,	0	1	3
Hand-picking weeds,	0	0	9
Fifth and last ploughing,	0	8	0
Total expense,	£.3	11	0

It thus appears, that summer fallowing an acre of land, on an average, occasions an expense of L.3, 11s.; and had the grubber not been used, one or two additional ploughings would have been necessary, which, though they would hardly have rendered the soil so clean, yet would have added at least 9s. 6d. to the expense, the whole then amounting to L.4 : 0 : 6 *per* acre. Yet considerable as this difference is, it is not the whole benefit which is derived from the use of that implement in the fallowing process: for it is well known, that expedition is of the utmost importance in the conducting of rural operations; and as one man, with four horses in the grubber, will go over as much ground in a day, as six men and twelve horses can do with the plough, hence, in this point of view alone, the value of the former implement is of the highest importance. In cases where there is but a small quantity of root-weeds, such as *knot grass*, the saving of labour is still more considerable, as the grubber, going but once over the ground, is frequently found as effectual, in bringing these to the surface, as one additional ploughing.

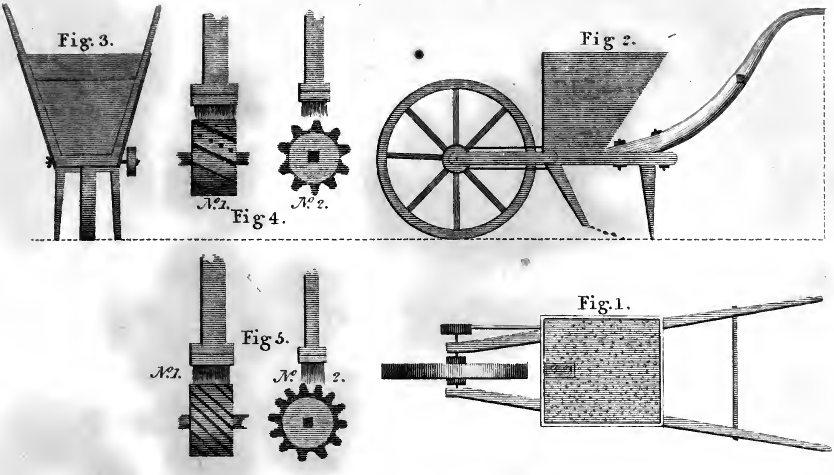
The grubber is likewise of use in other farming operations. In the preparation of the ground for turnips, that implement is in general found equally efficacious; the only exception being, where the soil is uncommonly soft, (as in some instances is the case upon the sea-coast), and at the same time remarkably full of root-weeds. Under such circumstances, the grubber is very liable to choke up; but in by far the greater number of situations where turnips are cultivated, that objection will not occur.

Where lime or compost has been applied, the value of the grubber, in working these valuable substances into the soil, is also of very great importance, for by passing it once along, and then across the ridges, the lime or compost is thoroughly mixed, without being thrown too deep into the ground, as frequently happens, when the plough is used for that purpose. After the grubber, however, has been used, the field ought to be ploughed, so that the ridges may be brought into such a form, as to facilitate the descent of rain-water into the furrows.

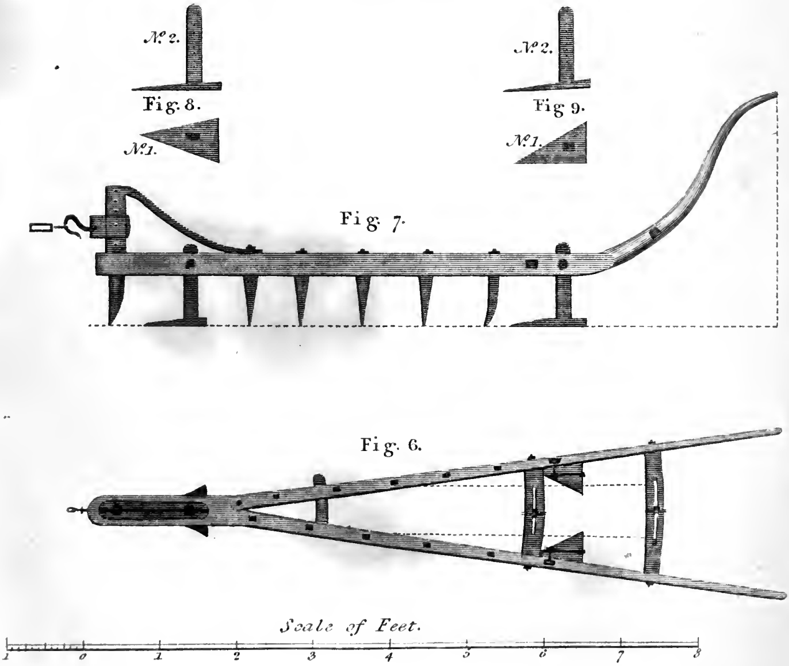
Another most important use of the grubber is, that it may be employed with great advantage, on all lands ploughed in autumn, or early in winter, to be sown in spring, for by passing it once over the field, the soil is effectually stirred and loosened to the depth of five or six inches, without burying the fine mellowed surface, or bringing up fresh soil, to run into hard and stubborn clods, which almost constantly happens, when the plough is used in such cases, in wet or clayey soils. Oats or barley may be thus sown, with much less expense, and consequently with more profit.

Grubbers, on an improved principle, are now made in the Lothians, entirely of cast iron, and at a moderate expense. It is an implement that cannot be too strongly recommended.

DRILL BARROW.



DRILL HARROW.



No. IX.

ACCOUNT OF AN IMPROVED MODE OF RAISING CROPS OF GRAIN, BY MEANS OF A DRILL-BARROW.

THE most general modes of depositing the seed in the ground, at present, are: 1. Sowing it broadcast on the surface; and, 2. By a drill machine. The advantages and disadvantages of both these modes have been already explained; but it is here proposed, to give a short account of a new mode of sowing, by a drill-barrow, an engraving of which is annexed. For a number of years, it has been the practice in East Lothian, to sow beans by such a machine; and several experiments were successively tried, of sowing wheat, barley, and oats, by the bean-barrow, with a smaller cylinder, so that the seed might be properly sown. But an ingenious artist, Mr Alexander Small, Leith Walk, (son of the celebrated inventor of the improved Scotch swing plough), has lately prepared some barrows for sowing grain, on so excellent a construction, that every objection to their use, is in a great measure removed.

The first idea was, to attach a box to the plough, so that the seed should be sown in the furrow, as the plough moved along. The plan of attaching the box to the plough, has certainly been attended with success, and in some cases may still be adopted; but upon fully considering the subject, it has, on the whole, been thought most advisable, to separate the box from the plough, for the following reasons: 1. By this means, when the box must be replenished with seed, a boy is only stopped; whereas when a plough is used, a man and two horses are hindered from working; 2. When the wheel is to one side, the plough is not so easily held; and, 3. The addition of the box, makes it more difficult to preserve the proper depth of the seed furrow.

The plan altered on these principles, may be thus described:

1. As soon as the plough enters, a boy with a box or barrow follows immediately, and deposits the seed in the furrow, which of course is completely covered by the next furrow-slice. This is easily effected, even in windy weather, when sowing broadcast is attended with difficulty.

2. The furrow-slice ought to be from three to four inches deep, in strong land, and from four to five in light; and,

3. The crop should be hand-hoed where a drill-hoeing machine is not made use of *.

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* In some cases, the following plan might be adopted: As soon as the ground is prepared for the seed-furrow, it may be covered with moist and rotten dung, and then, either the seed may be sown in the furrow made, and the dung raked over it, or the dung may be first raked into the furrow, and the seed sown upon the dung, and then covered with the furrow-slice. It would evidently be a great advantage, to have the seed sown with moist dung, particularly for barley in dry springs. This process is at least well calculated for the Flemish system of husbandry, with double crops.

The rows may be made either at ten or fourteen inches distance, but ten inches is considered sufficient by the generality of farmers, more especially where hand-hoeing is adopted. It is easy with a plough to make a furrow about ten inches wide; but where it is proposed to have a furrow of fourteen inches, it is necessary to have two ploughs, with narrow bottoms, to follow one another, each making a furrow of seven inches broad. Mr Dickson of Bangholm, near Leith, has tried various breadths between the drills, as nine, ten, twelve, and fourteen inches, but, on the whole, he prefers ten inches on light soils, because the wheat does not tiller, and the same breadth for oats and barley, though he thinks fourteen inches desirable, when wheat is sown on strong land, where it is likely to tiller much. The crops of grain and straw produced under this system, are fully as great, as under any hitherto tried. Mr Hume, of East Barns, had about forty-eight bushels per English acre; and Mr Dickson, in a field of thirty-two English acres, sown by a box attached to the plough, had no less than fifty-one Winchester bushels per English acre, which were harvested, and carefully thrashed on the 8th day of September 1815.

If this system answers, according to the expectations that are formed of it, the cultivation of grain might be brought to a degree of perfection, which it has not hitherto reached. The whole plan is so simple in its operations, that there can be no difficulty in its execution. No expensive or complicated machinery is necessary; on the contrary, the same simple barrow, by raising or lowering the brush, or by an alteration in the size of the *flute* or hollow part of the roller used, will answer all kinds of crops; and besides the other advantages already stated, the crop, from being sown in rows, gets more air, is easier cut down by the sickle, and produces more straw, than when sown in a scattered manner; and being completely cleared of weeds, it can be harvested to much more advantage.

It is only necessary to add, that when a respectable farmer, to whom the country owes so much for the introduction of drilled turnips, (the late William Dawson, Esq. of Graden), had the plan of sowing grain by the drill-barrow explained to him, he highly approved of it, and declared his full conviction, "that it would be the means "of bringing the culture of grain to perfection, as the seed would "have a level bed, and would receive an equal nourishment to bring "it to maturity."

N. B. In a recent communication from Mr Dickson, (16th August 1817), he states, that in the unfortunate season of 1816, his drilled crops were not so much sprouted as the broadcast, and that the heads were larger, and better filled. His neighbour, Mr Oliver of Lochend, finds drilling with a barrow equally advantageous.

No. X.

ON THE MANAGEMENT OF AN EXTENSIVE PROPERTY.

Whatever may be the case in regard to small properties, or those of a moderate size, it is evident that a great estate, spread over different counties, and perhaps situated in various parts of the united kingdom, is the most likely to be advantageously managed, when the preprietor calls in the assistance of two or three intelligent friends, to aid him in conducting so complicated a concern. No individual can be equal to such a task, unless he is in the prime of life, dedicates his whole time to the business, and gives up every other occupation;—whereas, in this country, it is expected, that great landholders, should direct their attention to public, as well as private matters, being hereditary members of the legislature, and hereditary counsellors of the crown.

Wherever an estate is of great extent, indeed, it has in general been found expedient by the proprietor, to nominate two or three commissioners, to assist him in its management. It is necessary that such commissioners should be men of prudence, possessed of comprehensive minds, and particularly distinguished by their knowledge of agricultural and rural concerns. They ought to make themselves thoroughly acquainted with all the affairs of the estate, by means of proper documents, such as reports on the boundaries;—the state of the farms;—the nature of the leases, and covenants in them;—the number of farmers;—cottagers, and live-stock;—the state of culture;—the rotations adopted, &c.;—with such plans of improvement, as any alteration in the size of farms, and the boundaries of each, may render practicable.

They ought likewise to have correct reports regarding the titles to the estate;—the political, and other privileges to which it is entitled;—also detailed information, in proper documents, regarding the state of the woods, fishings, mines, drainages, roads, bridges, &c.

These reports, properly arranged, and inserted in books, accompanied by sufficient references, would give a view of a great estate, capable of bringing every important particular, under the eye of the proprietor, or of his commissioners, *at a single glance;* whilst, at the same time, a curious and interesting account, of a great portion of a country, might thus be preserved, for future information.

In conducting the business of such a property, every legal question, and every demand of a tenant, or of a neighbour; every question about roads, bridges, churches, tithes, stipends, &c. will thus be brought under the consideration of intelligent men, capable of deciding, and judging impartially, on the points that come before them.

Under the superintendence of such commissioners, the affairs of a great property, would be as well conducted, as on the best managed small or moderate-sized estates; while the duties of the proprietor, would principally be, to carry those exercises of true benevolence into effect, which would consist,—in softening those stricter decisions, which such a commission might conceive itself bound to give;—or in granting those marks of approbation and reward, which, when bestowed by the proprietor himself, are the most likely to produce the most beneficial consequences.

No. XI.

ON THE MAKING OF WATERING PONDS, AS PRACTISED BY ROBERT GARDENER, OF KILHAM, IN THE EAST RIDING OF YORKSHIRE.

VARIOUS modes of making ponds have been adopted, with a view of simplifying the process, and lessening the expense; but *the improved practice*, invented by Robert Gardener, of which the following is a description, will be found to answer in almost any situation, in every country where the materials can be had. In many districts, the construction of ponds is an object of peculiar importance, and attended with great difficulty.

Begin with marking a circle on the ground, sixty feet in diameter, more or less, as the person chooses, or according to the supply of water which the pasture may require; and if of that diameter, let it be hollowed out into the shape of a bason or bowl, to the depth of seven feet in the centre. When the surface of this hollow has been raked smooth, let it be well beaten over, so as to reduce it into as even, uniform, and firm a surface as the nature of the ground will admit of. On this, well slacked and skreened lime, must be uniformly spread, with a riddle, to the thickness of two or three inches; the more porous or open the ground, the greater will be the quantity of lime required. This lime must then be slightly watered, to make it adhere firmly to its place, and great care must be taken, to spread it equally, so that no place may remain uncovered, as on the lime, more than on any thing else, depends the success of the work. On this lime must be laid a bed of clay, to the thickness of about six inches, which being moistened sufficiently to render it ductile, is to be beaten with mallets or beetles into a compact solid body, capable of being trodden upon without impression or injury. Great care is to be taken in laying on uniformly this mass of clay, and beating it into a compact body; for which purpose, no more must be spread at a time upon the lime, than can undergo the beating, while it retains a proper temper or consistence for the purpose. After the whole is thus finished, it is gone over several times by the beaters, and sprinkled each time with water, and care is taken, to prevent any cracks being formed, which might entirely destroy the power of retention.

Pure brick-clay is not required, but any tenacious earth, that by beating will become a solid compact body, will answer the purpose.

As soon as this operation has been duly performed, the whole surface of the clay is covered, to about the thickness of a foot, with broken chalk, fine gravel, or the chippings of mouldering stone, or limestone, to prevent any injury being done by the treading of the cattle. It is necessary to observe, that coarse stones must not to be made use of, as they are liable to be displaced by the treading of cattle. They are also liable to be pressed into, or through the bed of clay, or to be rolled down to the bottom of the pond; under all which circumstances, the beds of clay and lime are liable to be broken, and the water consequently let out of the pond. Sometimes the clay is covered with sods, the grass side being laid downwards, as a support to the gravel, by which some saving of covering may be made; or several inches thick of common earth is laid upon them, or upon the clay without the sods, by way of bed for the covering, where gravel, or such like materials, may be scarce, by which something may be also saved.

After the clay has been well beaten, some workmen water the surface of it, and fold sheep or pigs for a considerable time upon it; the treading of which is found to be serviceable, in rendering it more compact.

Some people, instead of using slaked lime, employ good mortar, made of lime and sand, well worked together, with which they cover the surface of the ground, to the thickness of about an inch. This, if carefully done, is thought to be the most effectual mode of rendering the bottom retentive; but the mortar is liable to crack before the clay gets bedded over it, which must be carefully guarded against. Ponds have been made, where a coat of mortar has also been spread over the surface of the clay, as well as under it, an approach perhaps as near as possible to perfection: but where lime bears an high price, the expense is thus considerably augmented.

The best season for making these ponds, is thought to be in autumn, as they are then likely to be filled the soonest, and are least liable to crack before they are filled. Should the weather prove dry at the time they are finished, it is well to cover their surface with straw, or litter, to hinder them from cracking.

These ponds are usually made at the foot of some declivity, where, after heavy rains, a slight run of water may be conveyed into them, from some road, or other firm surface; but many are placed without any such assistance for filling, or with very little, it being found, that the rain that falls upon their surface is, in general, sufficient for a supply, after they have been once filled. As it is desirable to get them filled, as soon as possible after they are finished, snow is frequently collected and heaped upon them, if possible in large quantities, the first winter after they are finished for that purpose.

Ponds of this kind, are usually made by what may be called professional people; men who go about for the purpose, and are chiefly or entirely engaged in it, and usually contract for the job. One of the diameter of sixty feet, and depth of six feet, may in most situations be executed for about L.15; one of forty-five feet by five feet, for L.10 or L.12; but some allowance must be made for the different prices of lime, or the distance it may be necessary to convey it, as well as the clay, or the other materials for the work. A pond of sixty feet diameter, by six feet deep, will contain upwards of 700 hogsheads of water; one of forty-five feet, by five feet, near 400 hogsheads—a vast supply, when obtained at so small an expense.

Experience now of many years, and the universal use of these ponds in this district, wherever wanted, have now proved them, when carefully made, so effectually to retain water,—to preserve it of so good a quality, when not fouled by the treading of cattle,—and to be applicable to so many situations, that they cannot be too strongly recommended in all high situations, where water may be much wanted, or in all other situations, where the water may be of bad quality. They are equally applicable to dry wolds, downs and heaths, which are without water, as to every fenny tract which has too much of it, but of a brackish or unwholesome quality.—*North Riding Report*, p. 243.

No. XII.

ON WARPING IN ITALY.

From some late accounts, which have been published of the agriculture, and statistics of Italy, it appears, that a species of warping has been long known in Tuscany. It is there called *colmata*. The rivers in that country carry down with them vast quantities of mud and sand, by which their discharge into the sea is impeded, and great marshes are formed, not only at the mouths of these rivers, but in their courses, when they are passing from one level to another. Torricelli, it is said, was the first who taught his countrymen to inclose the marsh with a dike or embankment;—to admit into this inclosure the water of the rivers;—to force this water, by means of sluices, to remain stagnant as in a lake, so as to deposit its mud;—and by the sediment so produced, to raise the level of the bottom. At one time, three or four inches of earth have been often deposited;—the operation has been several times repeated in the course of a year;—and the level so much raised, that the ground is no longer liable to be overflowed by the river. The soil thus acquired is of the highest fertility; and an instance is mentioned, of a piece of ground thus treated, which yielded 25 measures of wheat from one *. Necessity was the parent of this operation in Italy; whereas, on the banks of the Humber, it seems to have originated from accident, and has been carried on, by a zeal for improvement, and the prospect of gain.

* Edinburgh Review, for March 1817, p. 44, 45. Torricelli, the celebrated inventor of the barometer, was born *anno* 1608, and died *anno* 1647.

No. XIII.

ON THE MEANS OF IMPROVING THE CONDITION OF THE INDUSTRIOUS LABOURERS IN HUSBANDRY, AND EFFECTUALLY RELIEVING THEIR DISTRESSES.

By the Right Honourable Sir John Sinclair, Bart.

1. *On the Advantage of giving Land to Labourers.*

THERE is no point, with the policy and utility of which I am more deeply impressed, than the propriety of giving labourers in the country the possession of some land. With that advantage, they and their families can live better. They are thence enabled to go through more labour. A healthier and stronger race are reared, and one, not only fitter to defend their country against foreign enemies, but, having an interest in the soil, they are more likely to be impressed, with genuine patriotic feelings, and to feel more anxiety, to promote the happiness and prosperity of their country.

With the occupation of some land to fill up their vacant hours, labourers are more contented,—are attached to their own homes,—do not resort to ale-houses,—and enjoying a species of independence, set a higher value upon their character, and are more anxious to preserve it. When thus circumstanced, they are more respected, are better entitled to be trusted; and having property which they can call their own, produced by their own labour, on land occupied by themselves, and feeling how intensely they would necessarily deprecate all infringement upon that property, they are thence less likely to make depredations upon the effects of others. This idea will produce more feelings of honesty among them, than the best precepts, however ably urged, can instil.

By the cultivation of a small spot of land, a cottager can supply himself with that variety of food, (as fresh vegetables in summer, and roots in winter), which comfort and health require. He may be enabled to keep poultry with advantage. If he should fortunately be able to have bees, and if the surplus produce of his garden, should also put it in his power to rear, and still more to fatten a hog, his situation would be greatly ameliorated. When a garden also is attached to his cottage, his children are taught to dig, to weed, and manage it, and their time is employed in useful industry, and not wasted in idleness.

Letting land to labourers therefore, is of great utility to the labourers and their families, to the landowners, and to the community; and though, in every village, some idle and worthless persons will be found, who are not fit to be entrusted with, or capable of receiving benefit from land, yet the greater part will derive material advantages from such a possession. In many cases indeed, it has produced the beneficial effect of rendering those industrious, who would otherwise have been idle and profligate.

There are however, many difficulties in the way of cottagers getting a possession of land.

The generality of farmers dislike to see that plan adopted, for it renders the labourers less dependent upon them; and if the land were not occupied by them, the farmer would probably get possession of it; while some object to cottagers being allowed even to keep a pig, lest they should be tempted to steal food for it.

The agents of estates also, when the rent-day comes, find it much less troublesome to settle with six, than with sixty tenants; and they dislike being obliged to listen to the wants and complaints of the poorer occupiers. Indeed these agents consider the payment of the rent, not only more secure and less troublesome, but likewise not so liable to diminution, as the farmer will engage to keep the cottage in repair, which the labourer may not be able to undertake. By the united efforts of these prejudiced or interested persons, the landlord, having seldom time or inclination to investigate the subject very closely, is induced to agree to a plan thus strongly recommended to him.

I hope however, that the cause of the labourers, will no longer be overlooked or neglected, but that the landholders in the kingdom, will be convinced of the great public and private advantages that may be derived, from attention to the comfort and happiness of those most useful members of society.

It may be proper at the same time to observe, that there is no circumstance connected with this important subject, more to be deprecated, than the adoption of any complicated measures for improving the situation of the agricultural labourer. No plan can succeed on a great scale, that is not simple and easily executed. In general it is sufficient, that a labourer should have, 1. a comfortable house; 2. a good garden; 3. poultry; 4. a pig, (were it only for making manure for the garden); and, 5. bee-hives, where the situation is suitable for those industrious insects.

In regard to keeping a cow, it is only in cases where the circumstances are peculiarly favourable, and where the labourer is distinguished for his industry, good sense, and correct behaviour, that such a plan is to be recommended.

The land let to labourers, may either be employed, as a garden for raising vegetables, &c. or it may be sufficiently extensive for the maintenance of a cow.

1. *On Cottage Gardens.*—This interesting subject shall be considered under the following heads: 1. The advantages resulting from cottage gardens; 2. The proper size; and, 3. The mode of management.

1. No labourer in the country, can be in a comfortable state, without a garden. There are many cottagers unable to pay the rent of their cottage, when they have no land; but who, with the advantages of a garden, would find no difficulty in doing it. The cottage garden yields a great addition to the food, tends to promote the health of the family, and employs only their spare hours, in which nothing else would be done *. Their families are thus supplied with culinary

* It is an additional argument in favour of cottage gardens, that when a la-

vegetables in summer, and roots in winter, at a moderate expense: and the value of this benefit is greatly enhanced by the consideration, that it is the fruit of their own exertions *. The variety of food thus procured, contributes, not only to comfort, but to health. For the alleviation of some diseases, and the extirpation of others, is in many cases justly ascribed, to the more general introduction of cottage gardens. When a garden is of sufficient extent, the cottagers are also able, from its produce, not only to rear, but to fatten a hog, a valuable acquisition to every farm labourer, and indeed, without the manure obtained from which, the garden could not be cultivated with success. Profit may sometimes also be derived from fruit; and in favourable situations, bees may be kept with advantage. The moral effects resulting from such a system, cannot be too highly appreciated. When these gardens are of a moderate extent, they merely occupy the leisure hours of the family; thus tending to promote the comfort of the whole, to produce habits of industry, and to cherish a taste for, and knowledge of gardening, in the rising generation †.

2. The extent of the garden should be such, as not to occupy more of the labourer's time, than the regular engagements of the day will admit of. It is calculated, that the whole time which a farming labourer can spare from his ordinary occupations, to be employed on his own land, is 273 hours, or about twenty-three days in all ‡; but as these consist of fractional parts, and as the greatest leisure occurs, when the spade is least wanted, there will be some difficulty in adapting it to the necessities of the garden. It is probable, however, that matters may be so arranged, that a cottager may, in some instances, with the assistance of his family, cultivate from a quarter to even half an acre, without materially interfering with regular labour, hiring occasionally some aid. But in many cases, without assistance, he cannot advantageously attempt to manage one-half of that quantity; and it is well known, that a small spot, when properly cultivated, will raise a greater and more valuable produce, than one of double the size, if the management be imperfect.

3. A cottage garden ought to be managed on a simple plan, while, at the same time, some variety of productions is desirable, as under a proper system, it may be made to yield a weekly, and almost a daily tribute, to the table of the cottager. Much must depend on the cottager being supplied with good seeds; for five shillings *per annum*, laid out in the purchase of seeds, properly selected, and sown in due season, would render his garden doubly valuable §.

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bourer is obliged to return home, in consequence of bad weather, he may do something in favour of his little plot, in case the weather clears up, instead of loitering in ale-houses, and other places of public resort.

* Where a garden is small, it is a useful plan for the labourer, to procure a ridge of land, from some neighbouring farmer, for raising a stock of winter potatoes. The cottager manures the land, and gets the produce in return for the manure laid on, the benefit of which afterwards accrues to the farmer. This is an advantageous system to both parties.—*General Report of Scotland*, vol. ii. p. 64.

† General Report of Scotland, vol. ii. p. 62.

‡ Gloucestershire Report, p. 199.

§ Communication from Mr Salisbury, of the London Botanic Garden.

The fittest articles for cultivation in a cottager's garden, are summer cabbage, winter kail, potatoes *, carrots, peas, beans, leeks and onions †. French beans are recommended as being very productive and profitable; and the imperial cabbage, as being early, of a good size, and fine flavoured. At Wytham near Oxford, the culture of strawberries, in cottage gardens, has been found productive ‡. In other districts, the gardens of cottagers contain gooseberries and currant bushes, by which they frequently make some profit among their more opulent neighbours §. Useful herbs, as balm, mint, parsley, chamomile, &c. ought not to be neglected. In Cumberland, cottagers often pay their rent from the produce of two or three trees of the Carlisle codlin ‖. Other fruit-trees may also be planted with profit; but unless a cottager or his family, have a turn for horticulture, and the soil and climate are favourable to the production of fruit, it is more advisable to restrict his attention to the common vegetables.

The benefit of a garden to cottagers, must greatly depend on its being well inclosed ¶; on its having no forest trees planted in it **; and on the ground being well trenched, for if shallow, moisture is not retained in the soil, and its fertility is soon exhausted.

Mr Blaikie observes, that the Horticultural Societies, now happily established throughout the kingdom, are likely, in many respects, to become of great national benefit, and more especially by the patronage they extend to industrious labourers, in awarding liberal premiums to them, for the best cultivated gardens, and for the most improved garden produce.

The farmers also, frequently encourage their most deserving labourers when they have large gardens, by giving them selected turnip and mangell wurzell roots to plant in their gardens, and buying from them, at a fair market price, the seed which those roots produce. That is a profitable practice to the labourers, as the seed is ripened, and removed from their gardens, in good time for planting winter greens. It also suits the farmer's purpose, as they are certain the

* Cottagers should cultivate both early potatoes, as the champion or bread-fruit; and the red apple, or the red Cheshire, for late use.

† Plain directions for the culture of these plants in cottage gardens, by the late Mr Nicol, are inserted in the General Report of Scotland, App. vol. iv. p. 426.—It has been remarked, that the gardens of labourers are frequently seen better cultivated than those of farmers, as the labourer occupies no other land to distract his attention from the culture of his garden.—*North Riding Report*, p. 180.

‡ Berks Report, p. 306, note.

§ Bedfordshire Report, p. 458.

‖ See a description of this species of apple, General Report of Scotland, Appendix, vol. iv. p. 460.

¶ A good fence is necessary, as labourers are obliged to be from home a great part of the day, and sometimes take their families with them into the field.—*Gloucestershire Report*, p. 197.

** In some cottage gardens, forest trees are to be met with, though injurious to the produce, and in particular the ash, which on no account ought to be tolerated in that situation. The ash is frequent in such situations in Scotland, in consequence of an old Scotch statute, which required the planting of a certain number of ash trees, for every house that was built.—See *General Report of Scotland*, vol. iv. p. 432.

seed so saved, will be true to the sort, and without intermixture, which is a material object, frequent disappointments occurring, when such seeds pass through various hands, from the grower to the sower.

A labourer who occupies a large garden, and takes a pride and pleasure in its cultivation, is seldom found in ale-houses, or among disorderly company of any sort. His happiness is centered in his home, and he sets a good example for his children to follow, in his industrious domesticated habits. He can produce in his garden, and in his sty, substantial proofs of comfort, such as is desirable every honest industrious labourer in the country should enjoy. There can be no doubt, that the number of farm labourers, who enjoy these comforts, might be greatly increased, if they and their helpmates were to practise more industry and economy, and in particular, were less expensive in their dress.

In many situations, it is of great benefit to keep bees, for three hives will often pay the rent. Bee husbandry, however, requires so much attention, skill and management, that it ought to be attempted only by those who have a real taste for the pursuit, and in favourable situations for carrying it on *.

The produce of the garden must greatly depend on the care taken of it, and the careful collection of every thing that can be converted into manure. Let the hog-styes be kept clean, for the hogs will thus improve more, and the garden will become more productive. To the mine of dung from the styes, add the decayed leaves of the vegetables, the soot and ashes from the chimney and fire, the suds from the washing-tub, the sweeping from the floors of the house, cuttings of weeds from the side of the roads, and what may be collected on the roads, with every other article which will make manure. Every thing about the cottage is thus kept clean and neat, and the labour bestowed, by the increased comfort which results from it, is amply repaid.

In some parts of England, the gardens of labourers, and the entrance to their cottages, are adorned by flowering creepers, shrubs and plants, which, though not attended with any profit, yet indicate a greater attention to neatness, and an enjoyment of more comfort, than the occupiers of the miserable unadorned huts in other countries can possess †. The sight of such *superfluities*, is a gratifying voucher, in the words of Burke, "*That necessaries are not wanting.*"

2. *On Cottagers keeping Cows, and the Establishment of Parochial Dairy Farms.*

A distinguished friend to agriculture, (the late Earl of Winchelsea), drew up at the desire of the Author, an account of the advantage of cottagers renting land for the purpose of keeping cows ‡. Coming

* In Suffolk there is an Apiarian Society, for the sole purpose of encouraging bee husbandry in that district. It is on a most excellent system. The objects are, 1. To supply cottagers who are desirous of having them with hives; 2. To instruct those who have bees in the best method of managing them; and, 3. To dispose of the honey produced, to the best possible advantage. No application is attended to, unless the cottager brings credentials of character.

† Derbyshire Report, p. 214.

‡ Letter from the Earl of Winchelsea to the President of the Board of Ag-

from so respectable a quarter, it was received with much avidity by the public, and a number of philanthropic characters were induced to try the plan. It was evidently better calculated for a grazing district like Rutlandshire, than for an arable one, where the numerous operations of cultivation are requisite. The system therefore, was never materially extended.

In order to promote so useful a measure, I was induced to draw up a plan for enabling a cottager to keep a cow, on the produce of a small portion of *arable land* *. It was there stated, that three statute acres and a quarter of good arable land, worth from 20s. to 30s. *per* acre, would be sufficient, and a course of crops was pointed out for the management of this little farm. Such a plan was found might answer where the labourer was peculiarly intelligent and industrious, and pursued what may be called the *Field gardening* husbandry of Flanders, but could not be adopted as a general system. It has never therefore, been prosecuted to any extent †.

With every wish to see so important an object accomplished, as that of cottagers being enabled to keep cows, even on arable land, I am much inclined to think, there are so many obstacles to contend with, that it is hardly practicable to carry it on to any great extent. The difficulty which a poor labourer must experience, in procuring the original price of the cow,—the expense of keeping it,—the risks to which it is liable,—the difficulty that there would be in replacing it, if by any accident it fell ill, or died,—the attention it would require to feed it, and the labour that would be necessary to cultivate the extent of land, on the produce of which the maintenance of the cow depends, are all strong objections to the plan, and in many cases, present obstacles, which it would be hardly possible to surmount. I am therefore of opinion, that on the whole it would be more advisable, to establish a number of parochial dairy farms, in proportion to the size and population of the parish, for the purpose of supplying agricultural labourers ‡ and their families with milk, the substance best calculated for the nourishment of children. The arable parts of the proposed dairy farms, might be cultivated exclusively by the spade, which would give occupation to the labourers. The attention of the labourer might thus be directed to his own peculiar occupation, and to the cultivation of a moderate quantity of land, not exceeding one acre, to be employed in raising vegetables for his family. This plan of establishing parochial dairy farms, is perfectly simple and practicable. By the act 59. Geo. III. parishes are authorised to take land for the purpose of letting it to labourers. Let that law be extended, so that parishes may be enabled to take land, "FOR ESTA-"BLISHING OF PAROCHIAL DAIRIES, AND EMPLOYING LABOURERS

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riculture, (The Right Honourable Sir John Sinclair, Bart.), on the Advantages of Cottagers renting Land, printed *anno* 1796.

* It was contained in a volume of Miscellaneous Essays, printed *anno* 1802.

† On Sir Henry Vavasour's estates in Yorkshire, several cottagers adopted this plan most successfully.

‡ In large parishes small horses might be kept for conveying the milk to the more distant parts of the district.

"IN CULTIVATING THE SAME, UNDER THE SPADE SYSTEM OF HUS-"BANDRY," and the situation of that valuable class of the community, will be most essentially ameliorated. The union of these two objects would be in the highest degree advantageous to the community.

3. *Various Means of promoting the Interests of Labourers in Husbandry.*

1. There can be no doubt, that the situation of the agricultural labourers in husbandry might be improved in various ways. Of these, perhaps the abolition of the malt tax would be one of the most beneficial; for by this means, resorting to ale-houses would be rendered unnecessary, cottagers would brew their own beer, which would be of a superior quality, and the labourer would obtain an article, invaluable to him as a stimulus to labour, and by which he would be enabled to go through his work with much less fatigue and exhaustion.

2. In some parts of that celebrated agricultural district, Somerset, wheat is seldom thrashed with the straw, but the ears are cut off, and the grain separated by manual labour *. This is a plan which I would strongly recommend to the attention of farmers in every district, where any difficulty is found in providing employment for labourers, and where thrashing-mills are therefore so obnoxious. This plan may be attended with some additional expense, but then it possesses the following advantages: In the *first* place, scarcely a pickle of wheat is lost in the operation of thrashing; 2. The straw is more valuable for thatching; indeed, nothing can exceed the beauty of the roofs thatched with straw thus prepared, and they are more durable, furnishing no attraction to rats and mice; and, 3. The straw lasts much longer as litter, an important object where that article is expensive.

3. Spade culture ought to be extended as much as possible in the culture of arable land, for it is proved by Mr Falla and others, that the additional expense would be amply repaid by the increased produce. In early ages, when oxen and horses were cheap, and fed at little or no expense, and when labourers were not sufficiently abundant for extensive cultivation, the invention of the plough was an invaluable discovery. But now matters are totally changed,—cattle and horses are dear,—the implements of husbandry are expensive,—labourers are abundant, and their wages low; and hence it may often be found more advantageous, to employ human than animal power. If that principle, indeed, were extended, a considerable portion of the land now occupied in producing food for horses, might be employed in raising food for man, and an immense additional population might be maintained, without any importation of grain from other countries.

4. The system adopted in many parts of England, that of paying a part of the wages of the agricultural labourer out of the poor's rates, is

* This process is called in Somerset, "*Ear-Pitching.*" The implements are simple, and the process not difficult to execute. After a sufficient number of ears are accumulated upon the floor, the work of thrashing is executed by the common flail. By this process, the grain raised on the dairy farms ought to be thrashed.

a most exceptionable system, imposing, on the other classes of the community, a part of those burdens, to which the farmer, as he derives the whole benefit of the labour that has been employed, ought to be exclusively subjected. By this expedient, the manly and independent spirit of the labourer is broken down, and he is reduced to the condition, and impressed with the feelings of a mendicant *.

Such are the observations which have occurred to me, on the means of promoting the interests of the agricultural labourer; and I shall conclude with asking, if any one can figure to himself a more delightful spectacle than to see an industrious cottager, with his busy wife, and healthy family, living in a comfortable house, rented by himself, and not through the medium of another, cultivating his little territory with his own hands, and enjoying the profits arising from his own labour and industry; or whether it is possible for a generous landholder, to employ his property with more satisfaction, or in a manner more likely to promote, not only his own but the public interest, than that of endeavouring to increase the number of such cottagers, and encouraging, by every means in his power, the exertions of so meritorious and so important a class of the community.

Conclusion.

It is hardly possible, sufficiently to estimate the importance of this subject. The agricultural labourers in Great Britain alone, exclusive of Ireland, amount to 800,000 families, or 4,800,000 souls. How can any Legislature be more usefully employed, than in promoting the prosperity and happiness of so valuable a body, on whose labour, both rich and poor, must ultimately depend for their subsistence? The means therefore, by which their situation could be improved, is one of the first objects, to which legislative attention ought to be directed. Hence the plan of "*Field Gardens,*" brought forward by Captain Scobell, R. N., and so strongly recommended by the Bath and West of England Agricultural Society, cannot be too generally adopted.

The bill recently brought in by Mr Sadler also, is likely to produce some important amendments in the poor laws; and they would necessarily derive some most essential improvements, if the Lord Chancellor Brougham could find leisure, to direct his powerful mind, to that most interesting subject.

* See Colonies at Home, p. 3. and 27. In some thinly peopled districts, perhaps milch goats might be kept, to supply the families of cottagers with milk, as is done in Wales, and some parts of Ireland.

ADDENDA.

No. I.

OF THE VARIOUS ACCIDENTS TO WHICH CROPS OF GRAIN ARE LIABLE.

HOWEVER interesting it may be, to discuss the accidents to which our crops are liable, yet, in a condensed work like the present, only a general view of them can be given. They may be briefly explained in the following order: Heavy Rains, — Fogs or Mists, — Dew, — Frost,—Hail,—Snow,—Violent Heat,—Lightning, — Calms,—Variable Weather,—Blights,—Birds, and Quadrupeds; nor ought the minute, but voracious Weevil to be omitted.

1. *Rain.*—Heavy and long-continued rains are injurious to grain crops in every stage of their growth. Such rains, sour and chill the ground, keep the roots of plants so wet, as to retard their growth, and to lodge the crop when it approaches maturity, thereby depriving the ears of the grain, of a due supply of air, and overcharging the vessels with moisture, while in harvest, they render it difficult to reap and secure the produce. And if much rain happens to fall when any species of crop, (and especially wheat), is in flower, it not only retards the process of fructification, but, by washing away the pollen or *farina fecundans*, prevents the proper sexual connexion, without which perfect grain cannot be formed.

2. *Fogs or Mists.*—The diseases, or defective qualities of grain, and particularly of wheat, are sometimes occasioned by a course of thick gloomy weather, especially if it happens when the plants have come to full size, and are ripening their seeds. For though wheat grows in a great extent of latitude, it requires much sunshine to bring it to maturity, and to form the grain of proper quality.

3. *Dews.*—The ordinary dews are highly propitious to the growth of all sorts of plants; but when, from a slight degree of frost, or any other cause, the dew is rendered clammy and glutinous, as sometimes happens in this variable climate, it rests too long on the foliage of the plants,—shuts up their pores,—intercepts perspiration,—retards the circulation of the nutritious fluids, and impairs the health and growth of the grain. What is called honey dew, *(suffusio mellita)*, does not proceed however, from atmospherical influence, but arises from some interruption of the circulation, in the vegetable fluids of the particular plants on which it appears *.

4. *Frost.*—The young plants of wheat, are sometimes injured by very severe frosts in winter, and still more, by alternate frosts and

* Dorset Report, p. 209.—Dew-drops have frequently been shaken off the ears of grain, by means of ropes, and other contrivances, and if done before the sun rises, *with success.* About Bakewell in Derbyshire, it was formerly the practice, for two men, walking in the furrows, to dash the dew off the ears of wheat, to prevent the effects of the mildew.—*Derbyshire Report*, vol. ii. p. 321.

thaws in the spring. In proper clay and loam soils, the winter frosts, though they retard the growth, do not often kill the wheat plants. But in the lighter sorts of soil, the frost, even in winter, often raises the surface of the ground, so as to turn the plants out of root; and it is still more injurious, in that respect, in the spring, when the sun thaws the soil in the day time, and the frost binds it up at night. Frost is seldom fatal however, to grain crops, while they are only in their grassy stages of growth. But when the plants are making their principal shoots, and coming into flower, and when they are then growing faster, and far more luxuriant than at any other stage, the least breath of frost on the tender growth is hurtful. Fortunately, however, frost seldom happens when the grain crops are in that delicate stage. They are more frequently hurt by frost at a later period of their growth, as will be afterwards noticed when the subject of mildew is discussed *.

5. *Hail.*—In some parts of the Continent, storms of hail do such injury to the crops, as, in many instances, to desolate whole districts; but in Britain, hail is seldom injurious to any great extent. In the month of July 1733 however, a storm of hail commenced its course on the shores of Kirkcudbright, took its direction northward by Sanquhar, ran along the heights that divide the county of Lanark from those of Ayr and Renfrew, and went by Stirling into Perthshire. Heavy rain fell for many miles on both sides of that course; but the hail was so large, and fell in such masses, as entirely to cut and destroy the growing crops, for about a mile in breadth, and through a course of country of more than one hundred miles in length. Nothing nearly equal to this, has ever been known to occur in Scotland, when the crops were in an advanced stage of their growth †.

6. *Snow.*—When the wheat crops are covered with snow in winter, they are secured against the severity of the frost, and their future

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* It is ascertained, that if early pease, or potatoes, in a garden, have been attacked by the frost, any damage may be prevented by watering them before the sun has got up; for it is the warmth of the sun, acting on a frosted plant, that occasions the damage.

† In Italy, hail is a formidable enemy to vegetation. In Tuscany, in the spring, and in Lombardy, in summer, it has destroyed, *in one hour*, the most flourishing crops of wheat and rice.—*Professor Symonds' Communication on the Husbandry of Italy*, in the Annals of Agriculture, vol. i. p. 207.

In the Buckinghamshire Report, p. 8, there is an account of a hail storm that happened in that county, which did considerable damage; but the effects of those storms on the Continent are quite terrific. One happened near Rome, on the 23d July 1818, where the hailstones weighed eighteen ounces. Several persons were dangerously wounded; a number of animals were killed, and the crops, which promised a magnificent harvest, were totally destroyed. See also an account of a dreadful hail storm in Scotland, *Statistical Account*, vol. iii. p. 70.

Thirty-three of the unfortunate sufferers by a hail-storm in Essex, signed a declaration, that they were entirely unable to bear the losses which they sustained, and could not go on with their business, unless relieved by the contributions of the charitable.

At Berne, with the approbation of Government, a society has been established, called "The Hail Insurance Society," for effecting insurances against loss produced by hail, the ravages of which are so destructive in that neighbourhood.

growth is thereby promoted; but it seldom happens, that snow, to any injurious extent, falls on the crops in harvest. The only instance, for more than a century past, of snow hurting the crops, was on the 3d October 1782, when it fell to the depth of eighteen inches, over the greater part of Scotland, at a time when three-fourth parts of the oats were unreaped; and as it was followed by severe frost, for more than two weeks, the crop was in a great measure lost.

7. *Heat.*—Although crops suffer more in Britain, from cold and excessive rains, than from any other cause, yet heat and drought have sometimes injured them to a considerable extent, not only in summer, but even when ripening. The extraordinary heat and drought in the summer of 1826, was not injurious to the wheat crops, but it nearly ruined oats, barley, beans and pease. In 1819, a course of hot sunshine, for three or four weeks, about the beginning of September, completely destroyed a considerable portion of the crop of oats, in some parts of Scotland. Fortunately, much of the oat crops was nearly ripe, before that drought, and uncommon heat set in, but where it overtook the oats in a milky state, it was so powerful, as to wither the foliage, dry up the juices of the plants, and thereby to render the straw so shrivelled, that it could not bring the grain to perfection. The want of moisture, rendered the stems of the oats so sickly and feeble, that they ripened prematurely, with scarcely any meal or farina in the grain. Even the straw became dry, brittle, and so useless, that no cattle would eat it; and when reaped or handled, it emitted a disagreeable dust, and much of it was thrown to the dunghill. So long as oats remain in a grassy state, they can draw some moisture from the atmosphere by their leaves, but after the seeds begin to ripen, the foliage becomes withered, and if there is no rain, the plant becomes too dry, to be able to bring the grain to perfection.

8. *Lightning.*—Grain crops have often suffered by lightning, but seldom to any great extent in Britain. Some have imputed the blackish spots on the stems and foliage, to lightning, but these are evidently the effects of mildew, as shall afterwards be explained. Lightning cannot fail however, to injure grain crops, wherever it falls, and the disease or injury termed blight, is chiefly to be attributed to it.

9. *Calms.*—A moderate current of air, is always favourable to the health and life of plants, and its circulation is calculated to promote their growth, and to bring them to perfection. Wind shakes off superabundant moisture, and promotes the growth of every species of plants, by carrying to them that portion of their food, that has been reduced to the state of gas, and which they take in by their leaves and foliage. On that account, some have complained of the interruption given to the current of air by plantations, high hedges, &c.; but it ought to be remembered, that though moderate gales are beneficial, yet high winds and cold blasts are injurious to the land, the crops, and the cattle, and therefore shelter is required. We have occasionally too many calms in Britain, but these are not nearly so injurious, as our cold winds and stormy blasts.

10. *Variable Weather.*—Every excess of wetness, drought, cold or heat, is injurious to the crops, and every sudden transition from one to another of these, serves to increase that injury, by operating

too severely on the tender vessels of the plants, weakening them to such a degree that they require weeks to recover.

11. *Blights.*—Plants are sometimes injured by atmospherical influence, or by means of *blights*, as they are called. These sometimes arise from the unequal distribution of the electric fluid, or from lightning, which frequently kills the plants, injures their health, or prevents their filling. The effects may be observed by the blackish spots and patches in fields of wheat, sometimes in a zig-zag direction, where the stalks have little or no grain in the ears. In the spring season, after a warm and dry wind, there is sometimes a blight of a different sort, arising from an excessive perspiration, which enfeebles the plants, more especially if the wind is easterly,—and it either destroys them, or checks their growth. It may also be occasioned by strong winds injuring the grain, when it is in flower, so as to prevent the impregnation of the pollen; or when the wind shakes the plant so much, as to injure the culms, or loosen the roots, when the grain is in an imperfect or milky state, so that its maturation is prevented. But as these evils proceed from causes over which human control does not extend, it is unnecessary to enlarge on the subject.

12. *Birds and Quadrupeds.*—Crops in every stage of their growth are exposed to the depredations of the feathered tribe. Crows, pigeons, sparrows, game, small birds, &c., not only pick up part of the seed, when it is committed to the ground, but some of them, are constantly nibbling at the grain, from the time it is formed, until it is secured in the barn-yard. Even when that is effected, mice and rats continue their depredations, after the grain has been lodged in the granary.

13. *The Weevil.*—After the grain has been converted into flour, the voracious weevil attacks it in the barrels in which it has been carefully deposited, and frequently accomplishes its destruction *.

All these circumstances prove, 1. On how precarious a footing the profits of farmers are placed; and, 2. That the hazards to which those crops are liable, on which our subsistence depends, are more numerous, than, when the subject is first brought under our consideration, could possibly be imagined.

No. II.

ON THE NATURE OF THE DISEASE, CALLED "THE SMUT" IN WHEAT, AND THE MEANS OF PREVENTING IT.

This disease, in French, is called "*Le carie,*" and in botanical language, "*ustilago.*" It is a species of degeneracy of the grains in the ears of wheat, by which the substance that should form flour in the grain, becomes entirely changed into a black powder, similar to a puff ball, or dusty mushroom, *(lycoperdon globosum.)* Wheat affected with this disease, when mixed with seed in a sound state, diminishes its value, imparts a dark colour to the flour, and is said by

* It is said on the Continent, that the smell of hops destroys the weevil. Tar should also be tried.

some to possess noxious qualities. The disease has a great tendency to spread, and to contaminate all the adjoining grain, rapidly extending the mischief. No wonder therefore, that its ravages should have commanded the attention of husbandmen, in all ages, and in almost every country. It was formerly so common, that in some countries it was not unusual, to see twice or thrice as many smutted ears of corn, as sound ones. Fortunately, the means of preventing it have long been in the power of every farmer, for any operation that completely frees the seed from smutty powder (the source of the infection), or that destroys it by acrid, corrosive, or poisonous applications, will have the effect of securing a clean crop *; and though sometimes crops may escape without preparation, that is no reason, why every rational means should not be adopted, to guard against such an evil.

As a safeguard, it is an excellent practice, before the wheat seed is first put into any liquid, to run it, *very gently*, through a riddle, when not only the smut balls, but the imperfect grains, and the seeds of weeds, will float, and may be skimmed off at pleasure, which is not the case when the seed is put hastily into the brine or water †.

Numerous are the modes by which smut may be prevented; as, 1. By pure cold water and lime; 2. By boiling water and lime; 3. By water impregnated with salt; 4. By urine pickle; and, 5. By a variety of other processes, to be briefly enumerated.

1. *Pure cold Water and Lime.*—So important an operation, as the preparation of seed wheat, ought not to be performed in a slovenly manner, if the object be, to secure with certainty, the future crop, from so destructive a disease as smut. It may be effected, however, by pure cold water, provided the seed be washed in several waters, frequently stirred, so as to give the light grains an opportunity of rising, that they may be skimmed off, and repeatedly changed, until it be perfectly clean. It should then be dried by quicklime, slaked either with sea, or with boiling water ‡.

2. *Boiling Water and Lime.*—This mixture, when properly applied, is found to be effectual. Sometimes chalk-lime, recently burnt, is put into a copper of boiling water, and as soon as the lime is dissolved, the mixture, at this degree of heat, is poured upon the wheat, previously spread upon a stone floor, and the wheat and mixture are immediately well turned together with shovels §. Sometimes the wheat, put into a common wicker basket, is dipped two or three times in a mixture of hot water and quicklime ‖; and sometimes boiling water and quicklime have been successfully used, after the seed has been well washed and skimmed ¶.

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* Sussex Report, p. 85, note.

† Communication from Mr Blaikie, at Holkham.

‡ Northamptonshire Report, p. 89; Surrey Report, p. 217; Cornwall Report, p. 60; North Riding Report, p. 112; Annals of Agriculture, vol. xxi. p. 210.

§ Middlesex Report, p. 207. ‖ Dorset Report, p. 212.

¶ Buckinghamshire Report, p. 179. An experienced agriculturist has used this pickle for his seed wheat during the space of 15 years, and with uniform success, though he was twice or thrice under the necessity of using smutty

3. *Salt Water* *.—It is a still more effectual practice, to make use of either fresh water, so impregnated with salt, that an egg will float in it, or of sea water, with such a quantity of salt dissolved in it, as to be equally strong, by which its specific gravity will be so increased, that all unsound grains will swim in the pickle. About a bushel of wheat at a time, is put into a sufficient quantity of this pickle, in which, when stirred, all the light or diseased grains will rise to the top, and may be skimmed off. The seed wheat is then separated from the pickle, spread upon the floor, and a sufficient quantity of new slaked lime, to dry the whole, sifted upon it †. If the wheat is to be drilled, after being limed, it should lie a day on the floor, or be kept for that space of time in sacks.

4. *Urine Pickle.*—Some farmers are satisfied with merely sprinkling a heap of seed with stale urine, and then drying it with lime; and there can be no doubt, that by this mode of pickling, if carefully done, the object may be effectually answered. Others prefer steeping the seed in pure water, (skimming off any light grains that may float on the surface), and then applying the urine to the seed. The grain thus first imbibes a harmless species of moisture, and the more acrid matter to be afterwards applied, only acts upon its surface, where the source of the evil is deposited. This is attended with some additional trouble, but is an excellent precaution, by which any risk of injury, from the after application of the urine, is prevented, should the grain not be immediately sown, which, however, is desirable. After the wheat has been pickled with urine, and dried with quicklime, if not immediately used, it ought to be spread as thin as possible, upon a stone floor, to become dry. If it be put close together, and lie in that state for a day, not a grain will vegetate.

5. Various other steeps and practices have been recommended, as soap-boilers' leys ‡,—a ley of wood ashes,—lime water,—a solution of arsenic §,—powdered wormwood in stale urine,—and kiln-drying

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seed. He generally added one gallon of soap-lees to ten of water, and kept the seed in steep, from 15 to 24 hours. But he agrees with the late celebrated Arthur Young in opinion, that steeping for 24 hours is necessary to prevent smut effectually.—*Remark by Edward Burroughs, Esq.*

* Tull informs us, that brining seed wheat, to prevent smut, was first practised about the year 1660, when a vessel with wheat was sunk near Bristol, and the grain so much injured by salt water, that though it would vegetate, it was considered to be unfit for bread. It was taken out of the vessel at low water, and sown in different parts. It was free from disease at the following harvest, when wheat in general happened to be smutty. This accident led to the practice of brining.

† East Lothian Report, p. 111.—In Norfolk, wheat previously moistened with pure water, is candied with lime, slaked by very strong brine. The lime is applied in its hottest state, and smut is thus prevented.—*Marshall's Norfolk*, vol. i. p. 219.

‡ Derbyshire Report, vol. ii. p. 116.

§ This is strongly objected to, from the hazard attending it, and its destruction of game. A farmer in Essex, who was accustomed to steep his wheat in a solution of arsenic, had his crops exempted from smut, but he was remarkable for bad health.

the seed, which, though a hazardous, is, when properly executed, a successful mode of preventing smut *.

In every preparation it is necessary, either to kill, or mechanically to force off, the semina of the smut.

The most effectual steep, for destroying the seeds of the smut that are attached to wheat, was discovered several years ago by Mr Benedict Prevost, and strongly recommended to the attention of the Author of this work, by that intelligent naturalist, *as an infallible remedy.* Instead of brine, urine, or any of the ingredients that have been mentioned above, Mr Prevost uses vitriol, (the sulphate of copper), in the following simple process. The steep or preparation is made up at the rate of one ounce of blue vitriol, dissolved in an English gallon (wine measure) of water, for every bushel of wheat. Into this mixture the grain is thrown, or passed through a sieve; and being frequently stirred for about half an hour, and the grain which swims on the surface skimmed off, that which has sunk in the liquid is thrown into a basket that the water may run off. It is next washed in rain or pure water, so as to prevent injury to the grain, and the seed is dried, either with or without lime, and then sown. The grain should be well cleaned, and thoroughly dry at the time it is put into the liquid. The grain, after being thus prepared, may be kept without injury, and the remedy, when properly used, may be considered "TO BE INFALLIBLE."

Having frequently recommended this preventive against the smut, after my having first discovered it in the course of an excursion to the Continent, I flattered myself that its efficacy would soon be tried by a number of zealous and experienced farmers. But it is a true saying in regard to agriculture, as well as many other arts, "*What is every body's business, is nobody's.*" Each individual wishes to throw the load off his own shoulders, in hopes that his neighbour will undertake the trouble and risk of the experiment. Hence, this important suggestion might have remained unnoticed, had it not fortunately attracted the attention of some public-spirited agriculturists in the town and neighbourhood of Birmingham. To them, the use of the *sulphate of copper,* (from their being more accustomed, than the generality of farmers, to articles connected with manufactures and chemistry), was not an object of apprehension.

Mr Richard Hipkys, of Paradise-street, Birmingham, was the first person, at least in that neighbourhood, who was prevailed upon to try the powers of the proposed application. He states, that in the autumn of the year 1817, he met with a small work, written by the President

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* At Wooler, in Northumberland, it is said, that passing seed-wheat loosely through mill-stones, so as not to injure the grain, has been found to prevent smut; the seed of the disease, which is commonly lodged in the downy part of the grain, being removed by that operation. Mr Prevost has proved, that smut originates from the seeds of a fungus, for he has grown it on moist cloths. See Hints on the Agricultural State of the Netherlands, Appendix, p. 5. There is a luminous exposition of the chemical nature of the smut in wheat, and a correct analysis, extracted from the works of Fourcroy and Vauquelin, in Mr Hoblyn's Prize Essay on the Diseases of Wheat, in the Papers of the Bath Society, vol. xix. p. 83.

of the Board of Agriculture, in which the sulphate of copper was recommended as a remedy against the smut. That he had no faith in steeps, from the previous want of success in the use of them, notwithstanding the application of the usual remedies, having had considerable breadths of wheat, rendered absolutely unsaleable, *for the four preceding years*, by the ravages of that destructive disease. Yet to gratify the wishes of an esteemed friend, he was induced to make a trial that year. That in the course of his experiments, he found his crops were free from disease, exactly in proportion to the quantity of sulphate used. That having ascertained there was no hazard in the operation, he caused the whole of his seed wheat, used in autumn 1818, and also some Talavera wheat that was sown in the spring of 1819, to be prepared in the manner to be afterwards described. The result was, that by the use of blue vitriol, he had a beautiful crop of wheat, entirely free from smut, *and every other disease*.

In the autumn of 1819, he sowed thirty-three acres of wheat, and in the spring of 1820, nine acres of Talavera and Cape wheat, prepared in the same manner. The result at harvest was again, crops of grain *entirely free from disease*.

In the seed time of 1819, Mr Hipkys induced a particular friend, whose soil and situation were perfectly different, to make a trial of the sulphate, which he did with the most satisfactory and decisive results. The particulars have been detailed by Mr Hipkys, in the Farmer's Journal, at that gentleman's particular desire. Letters subscribed by him, have been transmitted to me; and though he declines having his name mentioned, there can be no doubt, that the facts he states, may be confidently relied on, and that the success of this plan of preventing smut, is placed beyond the possibility of doubt.

The nature of smut is now well known. It is a small and delicate microscopic plant, which would soon be destroyed by the variations of the atmosphere, if wheat did not offer an asylum, where it could propagate itself. While it is only attached *externally* to the grain, and before its seeds, or germs, have penetrated into the plant, its germination may be effectually prevented, by any operation that will clear the grain of the smutty powder, or that destroys it by acrid, corrosive, or poisonous applications. If nothing effectual is done for that purpose, the smut penetrates into the plant of the wheat, while it is still very young. There it produces globules, which increase with the ear, and become perfect seeds when the wheat approaches to maturity. If however, the seed is fortified by a solution of copper, that substance not only destroys the germination of any smutty powder attached to the grain, but likewise prevents its being attacked, through the root, by any other parasitical plant that may be found in the soil, and thus enables it to escape other accidents, or disorders to which wheat is liable *.

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* Mr Hipkys states, that he had a superior crop of wheat, which had been sulphated, and escaped being lodged, while the field of a neighbour, of equal quality, was beaten down, and mildewed. This he attributes to the superior strength of the straw. He is not of opinion, that the sulphate will prevent the mildew; all that can be expected from steeps is, that through their instrumen-

The mode of using the blue vitriol, adopted by the gentleman whose name is not disclosed, was as follows: Into eight quarts of boiling water, he puts one pound of blue vitriol; and while it is quite hot, he mixes three bushels of wheat with five quarts of the liquid, and at the end of three hours, adds the other three quarts; and the three bushels of wheat are suffered to remain three hours longer, or six hours in all, in the liquid. The whole should be stirred three or four times, during the six hours, and the light grains may be taken off. Then add a sufficient quantity of slaked lime, to make the wheat perfectly dry. It may remain in a heap for six hours; it may then be spread open, and used the next day, but not sooner. Though it is recommended to be spread six hours after it has been limed, and put in a heap, yet there is no risk of its heating, and it may be kept longer than a day, without any risk of injury.

Mr Hipkys's mode of preparation is different. After dissolving five pounds of the sulphate in hot water, he then adds as much cold water as may be sufficient to cover three bushels of wheat; which is gradually passed through a riddle, in order that all the light grains may swim on the surface, and be skimmed off. After being repeatedly stirred, and cleared of the light grains, the wheat is suffered to remain in the liquid for five or six hours; but it has remained, in one or two instances, from twelve to twenty-four hours, without experiencing any bad effect. It is then taken out, and thrown upon the floor. If it is to be sown broad-cast, it should be crusted with lime in the usual way; but for drilling, it is stirred about until it becomes dry, which it generally does, in dry weather, in five or six hours. When the atmosphere, however, is moist, it will require double that space of time *. It may then be drilled, with as much facility as grain that had not undergone any operation.

After the first two or three bags, of three bushels each, have passed through this liquid, one pound of the sulphate should be added, for each succeeding bag, until from ten to twelve bags have been thus used; when a fresh quantity of the preparation should be made ready, in case the liquid should become foul or turbid.

Either of these modes may be adopted with a certainty of success.

This plan is surely superior, in point of cleanliness at least, to some of the disgusting processes that are frequently recommended for the same purpose; and is likewise attended by the following advantages: 1. The expense is trifling, as the price of the vitriol is not, in general, above from sixpence to eightpence or ninepence per pound; and after being used, in the manner above described, the water may be evaporated, and the remains of the sulphate will again crystallise. 2. It is a great advantage, that, with this preparation, liming is not necessary; as lime, *more especially recently slaked,* cannot always be had, and as the use of lime is so injurious to the drill machines, where brushes are used. 3. It is well known, that after wheat has been

tality, the plant may be thereby freed from a general aptitude to disease, and by being thus invigorated, it may be the better enabled to withstand those attacks, to which, in a less healthy state, it would be liable.

* Passing it through a pair of fanners would soon dry it.

steeped in other modes, it has been lost by keeping; whereas, when prepared by the sulphate, it may remain unsown for any length of time without injury *; and, 4. The plant is thereby so strengthened, that it is less liable to be lodged, or to suffer from other disorders; and though it does not prevent the rust or mildew, yet for the smut, when properly applied, it is an *infallible antidote.*

In order to do justice to the application, the grain should be perfectly dry, when the solution of copper is applied. The germination of the smut plant will then be effectually prevented, without injuring the vegetative powers of the wheat.

It may be proper to add, that M. Prevost's discovery was, in a great measure, accidental; and that the utility of preparations from copper has long been known in Flanders. The method has also been successfully employed by Mr Joseph Butler of Killamarsh in Derbyshire †. Mr Brownrigg in the county of Wicklow in Ireland, likewise uses vitriol, and with success ‡.

On this interesting subject, M. Desmazieres of Lisle, who has paid peculiar attention to the diseases of wheat, states in a recent communication to the Author, that the microscopic fungus which produces smut, *(uredo caries)*, attacks only the grain, which is entirely filled with it, and the powder, which was spread only in a very small degree before, remains in the grain when gathered and thrashed. Some means must be found, for destroying this contagious fungus, and this has been effectually brought about, by the various operations commonly made use of. How comes it then, it may be asked, that a field, where seed has been well prepared, should sometimes yield smutty plants? To this question it may be answered, that the seeds of rottenness, like those of smut, may be more or less scattered over the surface of the earth, at the very moment that the crop is cut down. Hence it follows, if we wish to obtain a pure harvest, that the earth itself ought to be purified, and that the ground to be sown or planted, should be covered with lime, or watered with a solution of sulphate of copper, before or after tillage.

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* It would be a good plan, for seedsmen to prepare the seed-wheat before they send it to their customers. Sulphated seed has been kept uninjured, in small quantities, from the 2d of November to the 24th of December.

† See Derbyshire Report, vol. ii. p. 116. He mixed two pounds of blue vitriol, in as much chamber-ley, as would wet twelve bushels of wheat, and after soaking, dried the wheat in quicklime.

‡ Report of the county of Wicklow, by the Rev. Thomas Radcliff, p. 256. Mr Brownrigg dissolved only a quarter of a pound of Roman vitriol, in warm water, and mixed it with one barrel of sea-water, strengthened with a stone of salt.

No. III.

ON THE RUST * OR MILDEW.

It is proposed to discuss this important subject under the following general heads, 1. The nature and appearance of the rust or mildew; 2. Its causes; and, 3. An account of such remedies as have been suggested, either to diminish, or to extirpate the disease.

1. *The Nature and Appearance of the Rust.*—This disease usually appears in wheat, in the month of June, after the plants have grown to their full length, and before their seeds have ripened. Its first appearence is on the leaves and stems of the plants, in the shape of spots of a dirty white colour. They soon become yellow or brown, and afterwards black; and they seem to rise, thicken, and grow up in a roundish shape, on the stalk and leaves of the plant. From the time that these spots are found, the vigour and luxuriant growth of the plants evidently decline, and they make no further progress towards maturity. The stalk becomes so brittle, that it breaks under the flail, and emits dust of a disagreeable flavour, affecting the breathing of the workmen †.

As mildew, whenever it falls on grain crops, arrests the farther growth of the plants, and exhausts the juices that should have matured the grain, it is advisable, to reap the crop whenever the disease appears, and before it extracts the natural juices of the plants. The grain produced by an infected plant is small, poor, and of a pale colour, but as it contains none of the rust, it is not unwholesome food.

2. *Causes of Rust.*—Several of the accidents enumerated in a preceding section, (No. I. p. 53,) ‡ may contribute to the production of rust; but the principal causes are, having the land in too rich a state for corn crops; a too frequent repetition of so exhausting a crop as wheat, more especially on weak soils, which renders the application of much manure necessary; or when the crop meets with a check in its progress to maturity, and in that weakened state, is exposed to heavy rains, or variable weather.

It has been well observed, that when crops, *intended to ripen their*

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* Rust is the proper name, being a literal translation of the French "*La Rouille,*" and the Latin "*Rubigo.*" The disease has at first a brownish, *rusty*, appearance, which afterwards becomes black.

† Sir Joseph Banks's Account of the Cause of the Mildew in Corn. Communications to the Board of Agriculture, vol. iv. p. 399. See also the Translation of M. Desmazieres's Paper on the Diseases of Wheat, annexed to "Hints "on the Agricultural State of the Netherlands," p. 22. The celebrated Tessier was the first naturalist, who directed his particular attention to this subject, in his work entitled, "Traité des Maladies des Grains."

‡ Pliny (Lib. 18. c. 28,) attributes the rust to frost, and in this way it may be accounted for. If frosty nights are succeeded by hot gleams, disease is inevitable, unless the frost could be shaken off, before the influence of the sun is felt. It is a singular fact, that plants of wheat under trees escape rust, though the neighbouring crop is infested with it.

seed, are objects of culture, there is only wanted a degree of vigour and luxuriance in the plants, sufficient for that purpose; and if the fertility of the soil be raised to a much higher pitch than is necessary, or consistent with that object, injurious, rather than beneficial consequences may be the result *. Land may be roo rich for corn crops, and it is better to keep it in a *well-balanced condition*, or in a medium state of productiveness, than in too fertile a state †. A superabundant quantity of sap and juices, in vegetables growing on highly cultivated lands, it is evident, must necessarily render them more susceptible of the effects of sudden and extreme changes, and consequently more liable to disease. Besides, as mushrooms are produced on beds of dung, great quantities of manure must promote the growth of fungi, or parasitical plants, on the crops of wheat, if they are once infected. The wheat produced on the site of a dunghill, is always rusted, even in the most favourable seasons; and if the whole field is a species of dunghill, how can it escape ‡? The whole fungus tribe are seldom seen to grow, but from superfluous vegetable matter, as rotten wood, thatch, decayed hay, or some light rich substance, aided by a certain degree of heat and moisture; and there is no substance more analogous to such a production, the offspring of corruption, than dung. This may be regarded at least, as a proximate, or predisposing cause. If the seeds of the *fungi* float in the atmosphere, they may more easily find a *nidus*, on too succulent and lusty growing plants, the substance of which is in a tender state, and the pores more dilated, than in the hard straw produced by a compact soil §.

A too frequent repetition of crops of wheat, more especially when accompanied by great quantities of manure, to force a crop, or raised on soils unsuitable to the growth of that crop, will often have the same effect. The rust was but little known in the western, or the northern parts of England, or the southern counties of Scotland, until of late years, when every exertion has been made, to increase the quantity of that grain. Even clay lands, so congenial to wheat, have been injured by such severe cropping; but on weaker soils, as sandy and calcareous loams, the plant has suffered, in respect both of quantity and quality.

It is well known, that loose and open soils, such as turnip lands in

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* Hence the great advantage of having previously a green crop, to absorb the superabundant and injurious richness of the dung.

† Communication from Dr Coventry. It is stated in a letter from Mr Wm. Scott of Horncastle, (Farmer's Journal, Nov. 20. 1815), " That wet falling on soils *full of manure*, causeth too luxuriant a growth of corn, from whence springs mildew." This doctrine is sanctioned by the authority of Parmentier, who ascribes the rust, " à l'abondance d'un suc nourricier, resultant d'une vegetation trop vigoureux, plutôt qu'aux brouillards, qui n'y ont aucun part directe. Traité sur la Culture de Grains."—Vol. i. p. 242.

‡ Communication from John Middleton, Esq.

§ It is remarked by Mr Holdich, that the disease is generally in proportion to the broadness of the leaf; that it first takes place upon the upper leaf or sheath, out of which the ear issues. When this is narrow, small, and early withered, there is little danger from rust. Those broad leaves ought, if possible, to be got rid off, which perhaps may be effected, when the crops are drilled.

general, are the most apt to be rusted; and the reason is, that the roots in them, are the largest and the longest, and generally, in search of moisture, run the deepest into the soil. The stems are thence luxuriant, large and porous. The roots being long and straggling, often get into a noxious stratum below, or into one not productive of nourishment. When that is the case, the plant, formerly luxuriant, meets with a sudden check, (for it is only from the extreme points of the roots, that the plant derives its nourishment by absorption); and this sudden check *predisposes it to disease.* If then the month of July is accompanied by warmth and moisture, or even the beginning of August, the plants of wheat, in their weakened state, will be attacked by those *fungi,* to the propagation of which, that description of weather is so favourable, more especially in places where a free circulation of air is wanting.

In proof of these doctrines, it may be observed, that in loose and open soils, *treading the land thoroughly,* after it is sown, is an effectual preventive of the mildew; the roots being thus hindered from becoming loose and straggling, or getting into poor or noxious strata, whence no nourishment can be derived.

3. *Remedies against Rust.*—Among the remedies likely to diminish the effects of this fatal malady, the following have been particularly recommended: 1. Cultivating hardy sorts of wheat; 2. Early sowing; 3. Raising early varieties; 4. Thick sowing; 5. Changes of seed; 6. Consolidating the soil after sowing; 7. Using saline manures; 8. Improving the course of crops; 9. Extirpating all plants that are receptacles of rust; and, 10. Protecting the ears and roots of wheat, by rye, tares, and other crops.

1. In a plant of which there are such a number of varieties, as in the case of wheat, it is evident, that there may be some, distinguished by peculiar properties, and consequently less liable to disease *. It is said that the red wheats † are hardier than the white, and that the thin, or smooth-chaffed, are less apt to be rusted, than the thick-chaffed sorts. A variety of red wheat, called *creeping-wheat,* is much cultivated, on that account, in Yorkshire, and on the borders of England and Scotland ‡; and in Worcestershire, the farmers are partial, on account of its hardiness, to a species of cone wheat, originally from Courland, which is not so apt to be injured in bad weather.

2. Sowing wheat early, is a preventive that has been long recommended, with a view of having the ear filled, before the season is likely to be injurious §. In confirmation of that doctrine, it is remarked,

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* Spring wheat is said to be not so liable to be rusted as other wheat, in Dorsetshire, (Report, p. 213), and in South Wales, (Report, vol. i. p. 399), but equally so in Derbyshire, (Report, vol. ii. p. 119), and in other districts.

† Near Exeter, they have lately got a red foreign wheat, which, it is said, is not liable to be rusted.

‡ General Report of Scotland, vol. i. p. 447.

§ Worlidge's Systema Agriculturæ, vol. i. folio, p. 210. Printed an. 1681. On the advantage of early sowing, see Oxfordshire Report, p. 151, 152; Northamptonshire Report, p. 86; Berks Report, p. 200; Dorset Report, p. 209, 210, &c. By early sowing, the autumnal rains may be avoided, which put the that in the county of Somerset, the crops were formerly reaped much earlier than at present, the wheat harvest being generally over in the month of July), and that *the rust or mildew was then unknown* *. A farmer in Essex, who was accustomed to sow his wheat after beans, had his crops constantly rusted, but was no longer troubled with that disease, *when he sowed early* either on clover leys or after a fallow. In Bedfordshire, it is remarked, that wheat which *mays*, or turns yellow in that month, (which is, in general, the consequence of being sown early), never mildews †. It is no advantage, however, to have the wheat too forward in spring, and the sowing should not, on that account, be commenced earlier, than the beginning of September, even on fallows. A distinction ought likewise to be made, between cold, wet and heavy soils, and the light, dry and porous ones. It is well known that the latter, though even a month posterior, will be as soon, if not earlier, ready for the sickle.

3. As sowing early is attended with some disadvantages, (the nourishment in the soil being exhausted *by the stalk*, before the formation *of the seed* commences, the plants becoming winter proud, as it is called, or too forward for the season, and the crop being more apt to be injured by spring frosts), it would be very beneficial, to procure a sort of wheat, either from some foreign country, or raised by selection at home, that would ripen early, without being sown much sooner than at present. Nature produces numerous *varieties of the same species*, belonging to the same genus; and it is incumbent on the attentive and industrious farmer, to avail himself of the circumstance, from which so much advantage might be derived ‡.

4. It is a maxim with many farmers, " *That thick crops are sometimes mildewed, but that thin ones generally are so, in a greater or less degree* §." This arises from the following circumstances: When the seed is sown thick, the roots, instead of becoming long and straggling, are short and numerous. They are retained in the soil, more especially when the crop is drilled, that has been prepared for their reception, instead of wandering into strata, either poor or noxious. From the number of these roots and stems, the richness, which would be injurious to a few plants, only does justice to a number; for the same quantity of dung that might give twenty stems a disposition to dis-

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plant in a succulent or plethoric state, and consequently render it liable to infection. In dry weather, the straw is of a firmer texture, and affords no admission to the seeds of the fungus, that may be slightly attached to them, *if the disease be thus propagated.*—Bedfordshire Report, p. 383. That, however, is much doubted.

* Communications to the Board of Agriculture, vol. v. p. 202.

† Bedfordshire Report, p. 377.

‡ In Cornwall, they frequently sow a mixture of red and white, (provincially, *dredge-corn*), and the crops are more abundant when sown mixed, than when sown separately. When separate, the produce may not exceed 18 bushels per acre; whereas when the two sorts are mixed, the produce will amount to 24 bushels.

§ It may be asked, what is thick and what is thin sowing? That must evidently depend upon the fertility of the soil, and the period of the year when the seed is sown.

ease, would only yield a proper quantity of food, when it had fifty to nourish. There is *no tillering*, which necessarily produces weaker plants, liable to disease. By thick sowing in drills, all the advantages of treading, *in so far as respects rust or mildew*, will be obtained, for the roots of the plants will be short and numerous, and matted together, instead of being long and straggling.

It is proper here to allude to a communication of much moment, from which it appears, that in former times, when four bushels of wheat per acre were sown, the mildew was of much rarer occurrence, than since the practice of thin sowing has been adopted *; and there can hardly be a doubt, if the land is in good order; if the crop is sown early; if four bushels of seed are sown under the drilling system; and if the wheat is preceded by a green crop, so as to exhaust the pernicious qualities of the dung, that the crop of wheat will not be rusted.

It is proper to add on this subject, that it is much more prudent, to rely on the abundance of seed, than on the effects of tillering. When the latter is depended upon, during the time that the process is going on, much time must be lost, in the growth of the plant to maturity. The consequence is, both a later, and a more unequal ripening.

5. As wheat is not an indigenous, but an exotic plant, it might be less liable to disease, if the seed were occasionally changed by importations from foreign countries. The best Flemish farmers, regularly change their seed every two years, and assert, "that by this renewal "of seed, all the maladies of grain are prevented." Some purchase their seed from d'Armentiere, near Lisle, in French Flanders, while others recommend wheat grown in the *Polders*, (a species of salt marsh) in Holland, by means of which, they maintain, that the rust is avoided †.

It is likewise stated, on the respectable authority of an eminent naturalist, (T. A. Knight, Esq.) that by crossing different varieties of wheat, a new sort may be produced, which will completely escape being rusted, though the crops in the neighbourhood, and in almost every district in the kingdom, may suffer from it in the same year ‡. These circumstances tend to prove, that the rust does not depend solely on atmospheric influence, otherwise it could not be prevented by changes of seed, or by the crossing of different varieties.

6. The advantages of treading light soils, have been already explained §. It may be proper, however, to state the following facts,

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* See Mr Purt's Letter, annexed to Mr Blaikie's, printed in the Farmer's Journal, dated Holkham, Oct. 12. 1820.

† That eminent farmer, Robert Barclay, Esq. of Ury, in Scotland, brought his wheat seed from England every two years, and sowed only what was produced from English wheat the preceding year.

‡ In Italy, they recommend *thin* sowing, alleging, that as the infection may go from ear to ear, it is less apt to spread, when the ears are not in contact. But this seems to be erroneous doctrine.

§ A farmer has gone so far as to assert, that if the land, *be the soil what it may*, were trodden by a troop of horse, or a drove of cattle, after being sown with wheat, there would be scarcely such a thing as the rust known. But it is obvious, that treading in this way would do no good *to clay land*, but on the in support of the doctrine that treading will prevent the rust. In 1804, a farmer sowed 25 acres of a pea-stubble with wheat. After the usual operations of ploughing, scarifying, manuring, sowing and harrowing, it was trodden with sheep, to the consistency of a highway. The produce was 32 bushels per acre. For the sake of comparison, a part of the field was left in a light state, untrodden, and it was rusted. The same farmer had 14 acres of wheat planted with potatoes. The potatoe tops were pulled up, and the wheat sown on the surface. The potatoes were then forked and dug up, and the wheat trodden by the women and children in picking up the potatoes. The crop was free from rust, and of excellent quality. It has often been remarked, that when a field has been destroyed with rust, the headlands, which the horses have trodden much in turning, have generally escaped *.

7. The advantage of using saline manures, as a remedy against the rust, (a late discovery), is an important circumstance. Its success seems to be proved, by the practice of several farmers in Cornwall, who have been in the habit of sowing, about a fortnight before the turnips, the refuse salt of the pilchard fishery, as a manure for that crop, in the proportion of $31\frac{1}{2}$ bushels of salt, (56 lbs. each), per statute acre. They all agree, that they have never had any rust on their wheat, where this practice was adopted, though before, they were greatly affected by it †. The expense would be inconsiderable, since the tax on salt has been taken off. The uses of salt in animal life, prove how beneficial it would be to vegetables. In animals, it is found to promote perspiration, *and to prevent corruption in the juices* ‡; and consequently it is the most likely means of checking the propagation of fungi, and preventing that rottenness and corruption, to which wheat is liable when it becomes rusted. This doctrine is strongly supported by the following facts: 1. Rust is rarely experienced in the immediate vicinity of the sea, unless when the ground is greatly over manured §; 2. When sea-ooze is employed as a manure, impregnated as it is with saline particles, the crop generally escapes that disease; and, 3. Rust is little known in Flanders, where Dutch ashes, *full of salts*, are in use.

8. As land in too rich a state, is apt to produce rust, it is found to be an effectual remedy, if, previous to a crop of wheat, the dung be applied to a smothering crop, as tares, hemp, or cole-seed, on strong lands, or potatoes on light soils. Indeed wheat after cole-seed, is scarcely ever known to be rusted ‖. The general culture of that ar-

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contrary, might much injure the crop. Light soils are more liable to produce mildewed wheat, because the plants grow too fast in spring, and have long and straggling roots.

* It would not be difficult to invent a machine that would compress the land, if that operation would effectually prevent the rust.

† Particularly Mr Henry Sickler, whose practice was communicated in a letter to a respectable Member of Parliament, Davies Gilbert, Esq.—See also the evidence of Dr Paris, before the Salt Committee of 1818, p. 30.

‡ Code of Health, 4th edition, p. 178.

§ Essex Report, vol. i. p. 301; Dorset Report, p. 209.

‖ General Report of Scotland, vol. ii. p. 530; Dumfriesshire Report, p. 31, and Appendix, No. VI. p. 581.

ticle, and the use of Dutch ashes, impregnated with saline matter as a manure, tend greatly to that exemption from rust, by which wheat in Flanders is distinguished. Potatoes, *when the crop is large*, have sometimes had the same effect. A field was sown with wheat, partly after summer fallow, partly after clover ley, and partly after potatoes; the two former portions were found rusted, whereas the part where the potatoes had been sown, produced grain, plump and equal, and only deficient about one-tenth of the usual quantity. Wheat, after a thin crop of potatoes, is, however, often rusted in this country; but in Flanders, where the wheat is never materially injured by rust, potatoes are considered, in its highest cultivated district, (the Pays de Waes), as the best preparation for that crop. If too much dung occasion the propagation of *fungi*, which there is reason to believe is the case, smothering crops, by exhausting and diminishing the strength of dung, may take away that tendency.

9. Mr Clack, the respectable Rector of Milton in Devonshire, whose communication on the subject of rust is one of the most valuable hitherto published, strongly recommends the cutting down all those plants which retain the *fungi*, in their various stages, even during the severest frosts of winter, and which, on the return of a little mild or humid weather in spring, are thought to contribute to affect, with an astonishing rapidity, the earliest leaves and shoots of those vegetables, which are congenial to their propagation. These fungi flourish with such an extraordinary luxuriance, that in the course of a week or two, they seem to arrive at maturity, and disseminate their baneful effects throughout thousands of acres, on which depend the profit of the husbandman, and a large proportion of the sustenance of the community *.

Among the common plants, the colts-foot, the corn marigold, and the common couch, are said to be so favourable to the growth of these *fungi*, that no field can be free from rust, in which they are to be met with. Every exertion ought therefore to be made, for their total extirpation.

Some evergreens seem to retain these *fungi*, during the coldest seasons, as the box, when planted in low and damp situations, and above all, the bramble-bush, which ought to be cut down as close as possible, in hedges and coppices, at least once or twice a-year. The abele, or silver poplar, and willows, ought likewise to be kept under, as some of the chief causes of rust in their neighbourhood.

Several trees also, retain old fungi during winter, on their barks, as the black alder, the common willow, the hazel, the birch, and sometimes oak coppice. The barberry retains this source of mischief, in any fissure or cleft in the bark occasioned by injury, exhibiting numerous black pustules. These should be cut out. The contradictory accounts regarding the effects of the barberry-bush, in occasioning rust, may thus be explained. Where the skin is smooth and entire, the barberry does little or no mischief; where there are fissures

* Devon Report, p. 436.

in the bark, it proves the source of destruction. Hence also, when the barberry-bush is small, it does not occasion mildew *.

The practice of cutting the hedges, when a crop of wheat is sown, ought to be universally adopted, as a likely means of lessening the quantity of *fungi*, that would otherwise injure the crop. By this attention to the improvement of his hedges, and the extirpation of weeds, Mr Clack's glebe, on which, from time immemorial, the wheat was subject to rust, has been rendered nearly as free from that disorder as the open fields of his neighbours †.

10. A curious and most important circumstance, connected with the rust in wheat, remains to be stated. In the northern counties of England, where it is the practice to sow what they call *meslin*, (blend corn,) or a mixture of rye and wheat, it has been there remarked, that wheat thus raised *is rarely infected by the rust* ‡. It is singular, that the same circumstance has been observed in Italy. In an account drawn up by the late Professor Symonds, of Cambridge, on the climate of that country, it is recorded as a known, but extraordinary fact, " that wheat, mixed with rye or tares, (for it is a frequent practice there, to sow tares with wheat,) *escapes unhurt* §." It would appear, from tares being so useful, that the seed of the fungus must be taken up *by the root*, and that if the root be protected it is sufficient. This seems to be countenanced by other circumstances, as, that by treading the ground, and thick sowing crops of wheat, the crop is less liable to be infected by this disease ; the access of the seeds of the fungi, to the root, being rendered more difficult. The effect of tares as a preventive, may easily be tried. The double crops sown in Flanders, where the rust is hardly known, is another circumstance strongly favourable to the idea, of the advantage derivable from covering the roots of wheat from infection. Mr Knight is decidedly of opinion, that the disease is taken up *by the root*, (every experiment to communicate it from infected straw, to others, proving abortive) ; and indeed, if it were introduced at the ear of the plant, how could it descend, and infect solely the stem ? which is the case, unless when the disease is inveterate. Others attribute rust to the influence of the

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* Bedfordshire Report, p. 379.—The facts brought forward in the County Reports, Cheshire, p. 135, Cambridge, p. 131, seem to prove the fatal effects of the barberry, in occasioning rust.

† In a recent communication, dated 16th June 1817, Mr Clack states, that in the year 1811, he sowed a field of wheat after clover, which was notorious for rust ; but the crop produced next year was the best in the neighbourhood, which he attributes to his continued attention, in cutting out such shrubs, as were congenial to the growth of rust, in the adjoining coppice and hedges ; and to the consolidation of the soil, by filling it with sheep after sowing, for which purpose, a number should be collected, and slowly driven in a compact body, so as to give a simultaneous effect to the land.

‡ East Riding Report, p. 127.—Mr Tuke, the intelligent author of the North Riding Report, in a letter to the Author, dated 7th March 1818, states, that until the year 1815, rye grown amongst wheat, was generally allowed to be, in that district, a sure preventive of rust or mildew; but that year, rye itself was infected, and there was very little either wheat or meslin that escaped in Yorkshire.

§ See Annals of Agriculture, vol. iii. p. 153.

sun upon the roots. Hence the advantages of having a thick, rather than a thin crop; and hence, it is said, the beneficial effects of mixing rye with wheat, the rough bending head of the rye, protecting the earth from the power of the sun. It is also a singular fact, that plants of wheat under trees, escape rust, though the neighbouring crop is infested with it. This may be owing, either to the protection from the violence of the sun, or the moisture which is retained in the soil, by the means of the shade thus procured.

By one or other of these means, and the improvements which may be effected, by the observations of ingenious naturalists, and the experience of intelligent farmers, there is every reason to hope, that the diseases of wheat may, in a great measure, be so mitigated in their effects, that they will not in future be felt as a national calamity. For that purpose, however, it is necessary, that the diligent farmer should seize every opportunity of improving his knowledge in the nature of those diseases, should note down all the circumstances connected with the subject as they occur, and should compare his observations with those of others; that whether the causes of rust are general, or local, they may, as much as possible, be obviated. He may be assured, that it is "*The perfection of good management*," to discriminate the causes to which the disorders of grain are owing, and to apply the cheapest and the most effectual remedies.

No. IV.

ON THE MEANS OF PREVENTING THE RAVAGES OF 1. SLUGS; 2. GRUBS; 3. THE WIRE-WORM; AND 4. THE WHEAT FLY, (OR TIPULA TRITICI,) ON OUR CROPS OF WHEAT.

AMONG the various difficulties with which a farmer has to contend, in raising his crops, the ravages committed by a variety of the more diminutive tribes of animals, are much more important, and carried to a far greater extent, than is generally apprehended. These vermin are of several sorts; but the principal are, 1. Slugs;—2. Grubs, or large maggots;—3. The wire-worm;—and 4. The wheat-fly. The three former devour the plant when young; the latter attack the ear when it is coming to maturity *.

It is proposed to give a short account of the various measures *hitherto adopted*, for preventing the injuries to which our crops of wheat are liable from these destructive animals, accompanied by any *recent suggestions* for that purpose.

* Fields of wheat sometimes appear blighted early in the spring, by a small insect of the grub or caterpillar kind, lodged in the centre, or very heart of the stem, just above the root, but the plants afterwards recover, and shoot afresh. The insect is called the *musca pumilionis* by Linnæus, from its effects on rye, on which it chiefly feeds in Sweden, rendering the plants it attacks dwarfs. Annals of Agriculture, vol. xvi. p. 170; Trans. Linn. Soc. vol. ii. p. 76.

1. *Slugs.*—These are properly "*naked snails.*" They abound in spring, but only appear early in the morning, and late in the evening, more especially when the weather is warm. In the day time, they destroy the roots, and in the night, the blades, and other parts of the young wheat which they find above ground. They deposit their eggs in the earth. Powdered salt, saltpetre, and quicklime, are destructive to slugs; but lime-water is the most effectual, the least drop of it killing them. For that purpose, some diligent farmers collect them by means of pea-haulm, under which they shelter themselves, and they are then destroyed by a watering pot, by means of which, lime-water is sprinkled over them, when the haulm is removed. Sulphuric acid, even diluted, would probably answer the same purpose. Rolling the ground at night, or treading the surface with sheep, &c. are useful practices for the destruction of this species of vermin.

2. *Grubs.*—These are worms or maggots produced from the eggs of beetles, which ultimately are transformed into winged insects of the same species as their parent. They are likewise called "*the rook worm,*" rooks being so fond of them. They do great injury to the crops of grain, by undermining and feeding upon the roots of the plants. They are hardy in their egg state, and, when grubs, are invulnerable to the weather; but when passing from the aurelia state, rain and cold weather will destroy them. This maggot is so destructive, that if every season were equally favourable to its production, it would soon render the world a desert.

Various remedies have been recommended for destroying them, in particular, sowing salt with the seed,—strewing barley chaff on the surface, so as to entangle and destroy them,—spreading quicklime, or saltpetre over the field, before the plants get up,—employing ducks to devour them,—rolling the earth, more especially during the night, when the grubs are generally on the surface,—and treading the surface with sheep or pigs, and sometimes even with horses.

3. *The Wire-worm.*—This is a noxious animal, abounding both in old grass-lands, and in clover leys. It is very difficult to destroy them, as they are peculiarly tenacious of life. For five years, the wire-worm remains inhabiting the earth, till it changes its nature, and becomes a winged fly, (the Elator segetis of Linnæus) *. Some recommend, as the surest and most effectual means to get rid of them in old grass lands, to pare and burn the surface. Others suggest the sowing of spring instead of winter wheat, on the idea that the culture, at that season of the year, would destroy them. A plan has recently been suggested by Mr Radcliffe, an intelligent clergyman in Ireland, of paring the surface of old leys,—accumulating it in great heaps in the fields, and planting the field, and even the heaps with potatoes. By this means, a valuable crop is raised,—the destruction of the wire-worm is insured,—and an immense quantity of valuable earth, full of rich substances, is obtained. Another effectual mode of destroying the wire-worm is, to plough the clover stubble in July, as soon as the crop of hay is taken off, or the land has been cut for soiling, and then

* See Trans. of the Linnæan Society, vol. ix. p. 160.

to sow it with cole seed, on one furrow, to be eaten down by sheep. The treading of the sheep will effectually destroy the worm, and the wheat may be sown with safety in November. But the simplest mode of destroying wire-worms is, to delay ploughing till December; for if the land is then ploughed, they would be exposed, *in a torpid state*, to the frost, and the inclemency of the season.

That the reader may be induced, to pay more attention to this branch of the inquiry, it may be proper to state, that according to the most accurate calculation that has hitherto been made on the subject, no less a quantity than 60,000 acres of wheat, *in England alone*, are annually, either greatly affected, or completely destroyed, by this noxious animal *.

4. *The Wheat Fly.*—But of all the injuries to which wheat is liable, perhaps there is none more to be dreaded, or which is likely to be more severely felt, than that which is occasioned by a species of fly, whose depredations have been felt in other countries, as France, and America, as well as Great Britain †.

1. *France.*—The depredations of insects in the district called the *Angoumois* in France, are well known. They began their ravages in one particular canton. They successively spread through the whole of that district, and afterwards penetrated into the neighbouring provinces, particularly those which had any settled intercourse in corn with the Angoumois. Grains that have appeared quite perfect, have each contained one caterpillar. This is soon transformed into a butterfly, which becomes the stock of an innumerable line of caterpillars. It is thus that so deplorable a calamity spreads so quickly. But it requires a combination of several causes, (which fortunately does not happen very frequently), to favour the increase of these little animals, otherwise they would soon overrun any kingdom, and destroy the food of its inhabitants ‡.

2. *America.*—The celebrated Hessian fly in America, is another instance of the destructive effects of insects. It got the name of *The Hessian Fly*, because it was supposed to have been brought over in the straw-beds and baggage of the Hessian troops employed in the American war, who were first landed, an. 1776, in Staten Island and the west end of Long Island. It was there where the insect first made its appearance, and thence it spread into the southern district of New York, part of Connecticut, and Jersey. In the countries which it ravaged, the destructive powers of this insect are represented as in the highest degree alarming. In some districts, it is said to have so entirely cut off the produce, " that able farmers had not got

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* See Trans. of the Linnæan Society, vol. ix. p. 158.

† A valuable paper on the wire-worm will be found in the Stockholm Transactions for the year 1777.

‡ M. de Hamel du Monceau has written a work, entitled, " Histoire d'un Insecte qui devore les grains de l'Angoumois, avec les moyens que l'on peut employer pour le detruire." Paris, 1762, 314 pages in 12mo. This work details the advantages of all the methods hitherto proposed, for preventing the ravages of weevils, moths, and every other species of vermin that attack corn.

at harvest, a sufficient quantity of wheat for domestic uses, and, indeed, that they sometimes failed to reap the amount of the seed they had sown *." During the period that the Hessian fly was so celebrated for the mischief it occasioned, the Government of this country, prevented the introduction of wheat from America. Such precautions are not useless. The Egyptian bean has an insect in it *of considerable* magnitude, which completely devours the kernel of the bean before it becomes visible. This species of bean has been raised in some parts of England, and the same insect is produced. Some means should be adopted, to prevent the dissemination of so pernicious a production, otherwise the public will sustain a very considerable injury, which, by wise precautions, may be prevented. Any risk of this mischief spreading might have been prevented, had a public institution existed, to warn the farmer of his danger from its dissemination.

In the years 1787 and 1788, the greater part of the southern provinces of America, were infested with another insect, called there the "*Flying Weevil,*" which, when full grown, is a minute moth, somewhat resembling that which breeds in, and destroys woollen cloths. This insect is unfortunately well known in Europe as well as America. In fact, it seems to be the same insect that is called "The Wheat-Fly" in this country, and which has recently been so destructive in several districts.

3. *Great Britain.*—The mischief done by the wheat-fly in various parts of the kingdom, in the course of the year 1829, and the two preceding years, is frightful to contemplate. In one district in Scotland, (the Carse of Gowrie, in Perthshire,) the destruction it occasioned was estimated at little short of forty thousand pounds †. In many cases, the crop was not worth the cutting down; and in other instances, a fourth, a third, or even a half of the produce was destroyed. The myriads of this vermin, and the facility with which they fly from one field to another, in search of the plants in which their eggs can be safely and efficaciously deposited, seem to place their depredations beyond the powers of man to controul; and hence it has been asserted, that the only means of avoiding the mischief is, either to give up the culture of wheat until the race is destroyed, by the want of the plants necessary for continuing the species, or by patiently waiting, until seasons destructive to them naturally occur. If Providence however, has created so destructive an insect, as the *tipula tritici*, or wheat-fly, it has been no less attentive, to prevent its becoming too numerous, by making it the food of other insects. Indeed, there are no less than three *ichneumons* ‡ who seem to be intrusted with the important office of restraining, within due limits, the numbers of this destructive species, otherwise it would become too

* See Malcolm's Survey of Surrey, vol. ii. p. 258, on the authority of Dr Mitchell of America.

† Mr Gorrie, an eminent gardener in the Carse, calculates it at L.36,000.

‡ Trans. of the Linnæan Society, vol. v. p. 102, where they are described by Mr Kirby.

numerous to be subdued. The most extraordinary circumstance is, that one species of these ichneumons lays an egg near the egg of the fly. They are batched at the same time; and it is ascertained, that the maggot from the egg of the ichneumon, either lays its egg in the body of the caterpillar, when it can get at it, or devours the maggot, and thus preserves the wheat from its attacks *.

It is not here proposed, to enter into any philosophical discussion regarding the origin of the wheat-fly. It is sufficient to remark, that in spring, and in the beginning of summer, a species of fly is frequently found, in great numbers, which attaches itself to the heads of wheat, when the ear begins to appear, and where it deposits its eggs, which, in about ten days after they are placed in the ears, become maggots or caterpillars. These destroy the young pickle, by sucking up the milky juice which swells the grain, and thus, by depriving it of part, and in some cases perhaps the whole of its moisture, cause it to shrink up, and so to become, what in the western parts of England is called *pungled* †. In about three weeks after, when it has exhausted this substance, it drops upon the ground, where it shelters itself at the depth of about half an inch from the surface. There it remains in a dormant state, until the mean temperature is about 58°, when, vivified by the warmth of spring, it becomes a fly, about the time that the wheat produces the ear.

It is evident, that the same plan, that in our climate has been found so effectual for destroying the wire-worm, would be equally destructive to the wheat-fly, namely, that of leaving the soil which has produced the wheat untouched till November, and then exposing it to the inclemency of the weather, and in particular to the action of frost.

The great difficulty attending this plan is, to devise an advantageous course of crops, consistent with the idea of putting off the ploughing of the wheat stubble till November or spring. In the celebrated four years' rotation, 1. Turnips, 2. Barley, 3. Clover, 4. Wheat, the wheat stubble, as a preparation for the turnip crop, might first be ploughed shallow, and then a deeper furrow taken, by which the fly would be buried ‡, scarifying and ploughing at the same time, and ploughing *shallow* in spring.

I scarcely think it possible, that the fly can be destroyed, if the wheat is succeeded by clover, unless, perhaps, by severe rolling and treading §. The minuteness of the caterpillar, which is no bigger than the ordinary roman letter C, will preserve it in a great measure from the effects of pressure.

It is a great advantage attending any plan for the general destruction of this vermin, *that the young embryos are in general deposited*

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* See this interesting fact explained in the Quarterly Journal of Agriculture, published by the Highland Society, No. 3, p. 301.

† See Transactions of the Linnæan Society, vol. iii. p. 302.

‡ This is a plan recommended by Mr Gorrie in the Carse of Gowrie.

§ An instrument, at the same time, might be invented, similar in principle to the machine used at bleachfields for beating linen, which would probably destroy the maggots of the wheat-fly in the young clover by compression.

in the fields " *where the wheat grew* *." Under a proper system, therefore, the race might in a great measure be extirpated in any particular district. It is absolutely necessary however, that there should be a general combination for that purpose. Nothing done in the field where the new wheat is sown, can be of any use, for the fly is produced in fields, not under wheat at the time, and flies about, until it finds a plant suitable for its purpose.

In seasons, when the frost may not be supposed sufficiently violent, the desirable object may be obtained, by frequently stirring the ground, and by rolling and treading it, or burning stubble upon the surface, or by the use of hot-lime. Fumigations of tobacco or sulphur, made when the wind is favourable, might also render the ear disagreeable to this insect †.

If other means are ineffectual, surrounding the field of wheat with a belt of hemp, the smell of which is so peculiarly noxious to insects, might be tried ‡. The smoke of burnt weeds, and in particular of *sea weeds*, might also be of use.

In the course of these inquiries, I have seen very strong assertions made of the beneficial effects of *elder*, in protecting growing plants from the attacks of insects; in proof of which it is said, that when a whole district was infested with cockchafers, and scarcely a green leaf was untouched, the elder alone remained uninjured §. This plant is said, 1. To preserve cabbages from being injured by caterpillars; 2. To prevent blights and other effects on fruit and other trees ‖; 3. To protect crops of wheat from destructive insects; and, 4. To prevent the destruction of turnips by the fly, if elder bushes are drawn, for that purpose, along turnip drills.

It is recommended, to beat the cabbages with twigs of elder, or to make a strong infusion of elder water, and sprinkle it over the plants with a watering pot.

It has been remarked, that the greatest mischief is usually done to

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* Mr Sheriff has ascertained, that embryos are likewise deposited in the *triticum repens*, or couch grass, which delights to grow in hedges, and other neglected situations; but these could easily be extirpated.

† Trans. of the Linnæan Society, vol. v. p. 105.

‡ It may be proper here to mention a curious fact recorded in the Survey of the Hebrides. A cottager there, had his cabbages much injured by the caterpillar. He surrounded his little garden *with hemp*, and was no more molested by them, the smell of that plant being noxious to insects. The same idea exists in France, as appears from the following paragraph:

" Quelques personnes ont cru reconnaître, qu'en semant du chanvre sur toutes " les bordures d'un terrain, les chenilles n'ont point dépassé cette barrière, " quoiqu'elles infestassent tout le voisinage." *Code of Agriculture*, 4th edit. p. 523, note.

§ The dwarf elder *(Sambucus ebulus)* ought to be preferred, as its emits the more offensive effluvia. It is rather a scarce plant, but is found in considerable quantities on the banks of the Almond near Mill-Haugh, in Perthshire. The plant called Pokeweed, *(Phytolacca virginica)*, and henbane, *(Hyoscyamus niger)*, possess qualities so noxious to insects, that they might likewise be used with some prospect of success.

‖ The elder should be planted so as to entwine its branches among the fruit trees.

the late sown wheats, and that such as are sown early, receive little or no injury. When the grain has arrived at a certain degree of hardness and consistency, (which may be the case, with the early sown wheats, before the insect has made any material progress, or even commenced its operations,) the plant is not so liable to be injured.

Conclusion.

It is much to be lamented, that so important an object as the means of preventing the destruction of our most valuable crops of grain, should not have attracted the attention of Government; by whose means, discoveries might be made, which can never be expected from private exertions. By public encouragement, the inquiry would be carried on with energy, and probed to the bottom; and the most effectual means of preventing the mischief, would probably be ascertained. What subject can be compared to it in point of importance? At present, we are liable every year, not only to the loss of some millions worth of grain, but to all the mischiefs of scarcity, and even of famine. These would not probably be experienced in this country, were the ravages of insects, and the destruction by the mildew * prevented; objects which are certainly in a great measure attainable, if the inquiries regarding them were prosecuted with vigour, and if no expense were spared in collecting facts, and ascertaining, by careful experiments, the means by which such frightful losses might be prevented.

No. V.

PROGRESS OF A SHORT-HORNED BULLOCK.

The following account of the progress of a short-horned bullock, was drawn up, at my particular request, by C. Mason, Esq. of Clifton, near Rushyford, in the county of Durham, and throws much light on a curious and most interesting subject, the expense and profit of breeding that species of stock.

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* The writer of this paper, from his zeal to promote the improvement of British agriculture, was led personally to examine the husbandry of the Netherlands. He there found, that "*The Rust*" or mildew, which frequently occasions such devastation to the crops of wheat in England, was scarcely known. He prevailed on the Board of Agriculture, to offer premiums for the best accounts of Flemish husbandry; and regarding that point in particular, several valuable papers were sent over; but unfortunately, about the time they arrived, Government had resolved to abolish the Board, and actually sent all the papers belonging to that institution, (and these most valuable documents among the rest), *to the Tower of London*, where they still remain, carefully locked up, as if information that might prevent the miseries of scarcity or famine was unfit to be promulgated, and should be carefully concealed from the public eye.

Time.	Food.	Price of Food.	Total Expense.
1. From 1st April, when calved, to 16th June 1814, 11 weeks.	New milk, then skimmed milk with oil cake.	5s. per week.	£.2 15 0
2. From 1st June to 2d Nov. 1810, 22 weeks. (Total 33 weeks.)	Grass of inferior quality.	1s. 6d. per week.	£.1 13 0
3. From 1st Nov. 1811, to 8th May 1812, 27 weeks. (Total 60 weeks.)	Straw and turnips in the fold yard.	2s. per week.	£.2 14 0
4. From 7th May to 1st Nov. 1812, 25 weeks. (Total 85 weeks.)	The worst grass on the farm.	2s. per week.	£2 10 0
5. From 1st Nov. 1812 to 8th May 1813 25 weeks. (Total 110 weeks.)	Straw and turnips.	2s. per week.	£.2 10 0
6. From 7th May to October 12, 24 weeks. (Total 134 weeks.)	The best grass on the farm.	4s. per week.	£.4 16 0
7. From 1st Oct. to 11 Nov. 1813, 6 weeks. (Total 140 weeks.)	Aftermath.	5s. per week.	£.1 10 0
8. From 15th Nov. 1813 to 17th April 1814, 22 weeks. (Total 162 weeks.)	Straw and turnips.	5s. per week.	£.5 10 0

Sold when 3 years 6 weeks old. Total expense, £.23 18 0

Total weight, 65 stone, at 8s. 6d. per stone, - -	£.27 12 6
Life weight, sinking offal, which is the usual mode of selling fat cattle, - - - - - -	23 18 0
Total profit,	£.3 14 6

It would be extremely interesting, to have similar statements drawn up, of the expense of breeding other animals, from their birth, till they were slaughtered.

On the subject of profit, Mr Mason states, in a recent communication, that the calculation *for keep*, is made upon the principle, that 8s. 6d. per stone, will remunerate the breeder for the prices charged per week. For instance, if an ox eat 15 stones of turnips per day, in twenty weeks he will consume 30 tons at 8s. per ton. This will amount to L.5, 4s. in all, within a portion of 5s. per week. This would give the grower of 20 tons of turnips L.8 per acre, besides the advantage obtained from the manure. This would certainly be sufficient profit. But if his crop of turnips would produce from 30 to 40 tons per acre, all at the same expense, which is frequently the case, the profit would be still more considerable.

No. VI.

ON THE ROTATION OF CROPS ON THE ESTATE OF HOLKHAM, BY FRANCIS BLAIKIE, ESQ.

WHEN an account is given, of the rotation of crops in any particular estate or district, it is proper, that the soil and situation should be described at the same time, so that the reader may be better enabled to judge of the propriety of the system. For instance, upon Mr Coke's estates in West Norfolk, which is celebrated for its good husbandry, the soil varies from light dry sand, to strong loam, retentive of wet. But the greater part of the land is a friable sandy loam, naturally poor, but very productive, from being kept in a high state of cultivation. The subsoil of the whole district is calcareous, and is called clay, marl, or chalk, according to its texture.

1*st Rotation.*—The best, or first class of this land, is cultivated, either upon the four course shift, or upon the four and six courses alternately, as follows:

The Four Course Shift.

1. Turnips well manured, and part of the crop eaten upon the ground, or turnips and mangel wurzel, ("field beet,") in alternate ridges of four or more drills; the beet all drawn off, and consumed in the yards,—and turnips eaten upon the ground;—2. Barley;—3. Red clover, mown once;—the second crop folded, and eaten off by sheep,—a fresh piece being set out every day;—4. Wheat.

The Six Course Shift.

1. Turnips well manured, and part eaten on the ground;—2. Barley;—3. White clover and mixed seeds, mown once;—4. Pasture;—5. Pease;—6. Wheat with manure. Thus, in the ten years, the land received three dressings of manure, exclusive of the sheep-fold; and produced two crops of turnips, two of barley, two of wheat, one of pease, one of clover hay, one of mixed grass hay, and one year's pasture. The four or six course shifts, taken alternately, are preferable to a constant repetition of four course husbandry, and should be adopted, whenever a convenient opportunity occurs.

To a person unacquainted with the management of light arable land, and the use of rape cake, it will appear, that the three dressings of manure here mentioned, exclusive of the sheep-fold, are extraordinary high farming. But when the expense, and speedy application of the manure are pointed out, the wonder ceases. Thus, the average price of rape cake, including the expense of breaking the same into a powdered state, has, in the last ten years, been about L.5, 10s. a ton, and that quantity is usually allowed to three acres of land; and suppose rape cake manure only is used, and three dressings given in ten years, the whole comes to eleven shillings per acre per annum. The expense of laying on the manure is a mere trifle. A common waggon carries enough for six acres at one load; and one man sows by hand, broadcast, three tons of rape dust in one day, with which he covers nine acres, and for which the usual pay is one shilling a ton, or fourpence the acre. The Holkham horse machine, for sowing rape dust broadcast, is more expensive than the hand process; but it spreads the manure more regularly, and is more expeditious. It is particularly calculated for large farms.

2d Rotation.—Cropping for the second class of land.

A Four and a Five alternate Course Shift.

The occupier uses his discretion in having any particular part of the farm in a four course, and other parts in a five course, so that, "on the whole, he has not, in any one year, more than four-ninth parts of the said arable lands, under crops of corn, grain, or pulse."

The four crops on land of the second class, are, 1. Turnips well manured, and all or nearly all the crop eaten upon the ground;—2. Barley;—3. Red clover, mown once, the second crop sheep-folded, and if a weak crop, the stubble is mucked, or oil caked for the succeeding crop;—4. Wheat.

The Five Course.

1. Turnips well manured, and all, or nearly all the crop eaten upon the ground;—2. Barley;—3. Mixed grasses, mown once;—4. Pasture;—Wheat with manure. In the nine years, the land is manured three or four times, exclusive of the sheep-fold: and produces two crops of turnips, two of barley, two of wheat, one of clover hay, one of mixed grass hay, and one year's pasture.

Two years grass' layers upon light land, are liable to be stocked with wire-worms. Where that misfortune is apprehended, it is advisable to *reece-balk* the land in preparation for the wheat crop. The reece-balking, or rib-balking, is done soon after midsummer, and is performed by a common wheel plough with a broad-winged share. The land is only half broken; the turf or flag in the alternate rib, being skimmed off about two inches deep, and thrown flat on its back, the grass side down upon the unbroken ground. The effect of this practice is, that the wire-worms and grubs creep to the outsides of the ribs, and are eagerly picked up by the rooks. Those sagacious, useful birds, are generally in close attendance when wire-worms and other destructive insects are plentiful. Gamekeepers raise a hue and cry against rooks, pretending, that they destroy the eggs of pheasants and partridges. Those people are generally more attentive to the raising of rabbits, than they are to the preservation of birds; and the poor rooks are a convenient apology for the deficiency of game. When there are no rooks, the gamekeepers attach the blame to the cuckoo, to unfavourable weather, &c. &c. &c.

There is no loss in pasturage, from reece-balking two years' layers upon light land. The spring feed is eaten off before the ground is broken, and the grass grows vigorously afterwards, from the sides of the furrows in the ribs, and produces more good sheep feed than if the turf had not been disturbed. In the autumn, the broken turf is harrowed across the ribs, and drawn into the spaces from whence it was cut. The turf on the unbroken ground is also tendered, or half rotten by the time, from the broken turf having lain upon it, and thence excluded the air. The ground is then manured all over, generally with rape cake *in cobble*, and in the proportion of about a ton to three acres. The ground is immediately ploughed at the usual pitch, considerably deeper than the reece-balking, and the broken turf effectually covered. The wheat seed is thus drilled in at a proper season.

When wheat is sown on light land, upon two years' *alland*, or layers unbroken, it is apt to suffer in winter, not only from the depredations of wire-worms, but also from the frost heaving up the turf, and breaking the roots of the plants. Rolling and treading are good preventives.

3*d Rotation.*—The third class of land is thus cropped.

The Five Course.

1. Turnips well manured, and all the crop eaten upon the ground by mixed stock; the treading of neat cattle, along with the sheep, in such cases, is greatly beneficial to very light land;—2. Barley;—3. Mixed grasses pastured;—4. Pasture;—5. Wheat highly manured, or oats without manure.

4*th Rotation.*—There is a fourth class of light land in West Norfolk, still inferior, which is occasionally cultivated, and at other times used as sheep pasture and rabbit warrens. That land, when broken up, is usually pared and burned, and sown with rape for the first crop;—2. Rye or oats;—3. Turnips well manured, and all the crop eaten upon the ground by mixed stock. Other food being given to the stock at the same time, in cribs and troughs placed on wheels, and frequently shifted upon the turnip ground; a most commendable practice, and peculiarly suitable for all poor light soils. 4. Barley, well seeded with white clover, narrow-leaved ribgrass, and other permanent grasses;—5. Pastured, and so continued for a series of years, until the moss plants overcome the grasses; when the ground is again broken up, and undergoes a course of aration as before.

In the description here given, of the various rotations of cropping and manuring, no mention has been made of the application of calcareous substances. On that subject, it is only necessary to observe, that an intelligent and attentive farmer, does not require a chemical analysis of the soil, to direct him when calcareous manures ought to be applied. Experience, founded on common sense, is his unerring guide; he knows, that the cultivated soil requires a dressing of calcareous matter, when he sees his crops become proportionably more productive of straw than of corn. When the straw, particularly that of barley, becomes soft and feeble, or, as it is called, "lazy," and bends down, and knuckles under the weight of the ear,—when the scythe in mowing, rather breaks than cuts it,—also when the land shews an unusual disposition to produce annual weeds, such as the corn marygold, &c. these are certain indications, that the cultivated soil is deficient in a due proportion of lime. The subsoil dressing is usually laid upon wheat stubble, in preparation for turnips; also, upon two years' layers, in preparation for wheat, and sometimes upon young clovers, immediately after the barley is carried off, and the harvest is over.

No. VII.

The following communication was drawn up for this work, by Mr George Sinclair, author of that most important publication, the "*Hortus Gramineus Woburnensis.*" At the desire, and under the patronage of an illustrious friend to agriculture, John Duke of Bedford, he had carried on at Woburn, for several years, a number of experiments, to ascertain the most profitable means of promoting the improvement of permanent pastures,—of irrigated meadows,—of dry and upland pastures,—and of the alternate husbandry in general. The result of those experiments is contained in the work above mentioned, by the dissemination of which, an immense addition will be made to the agricultural resources of the empire, and the management of grass land, will be brought to a degree of perfection, of which hitherto it had not been considered susceptible.

The objects of this paper are, to point out, 1. The plants which constitute the produce of pastures on different soils; 2. The natural habits and comparative value of these plants; and, 3. The mode of culture to be pursued, in returning land to permanent pasture, *of the best quality*, after having been cultivated.

No. 1. *Plants which constitute the Produce of Pastures on different Soils.*

The plants which afford the principal grass in spring, and also a great proportion of the produce, are,

Meadow foxtail, *Alopecurus pratensis.*
Sweet-scented vernal-grass, *Anthoxanthum odoratum.*
Meadow fescue, *Festuca pratensis.*
Cocksfoot grass, *Dactylis glomerata.*
Meadow catstail grass, *Phleum pratense var. major.*
Tall oat-like soft-grass, *Holcus avenaceus.*
Creeping vetch, *Vicia sepium.*
Different varieties of rye-grass, *Lolium perenne var.*
Field brome-grass, *Bromus arvensis.*
Annual meadow or Suffolk grass, *Poa annua.*
Meadow oat-grass, *Avena pratensis.*

The following constitute the summer produce, principally:
Yellow oat-grass, *Avena flavescens.*

Meadow barley-grass, *Hordeum pratense.*
Crested dogstail grass, *Cynosurus cristatus.*
Hard fescue grass, *Festuca duriuscula.*
Rough-stalked meadow-grass, *Poa trivialis.*
Smooth-stalked meadow-grass, *Poa pratensis.*
Woolly soft-grass, or Yorkshire fog, *Holcus avenaceus.*
Perennial red clover, *Trifolium pratense perenne.*
White or Dutch clover, *Trifolium repens.*
Yellow vetch or *meadow vetchling*, *Lathyrus pratensis.*
Smooth fescue, *Festuca glabra.*

Those which vegetate with most vigour in autumn, and during open winters, are,
Creeping bent or fiorin, *Agrostis stolonifera var. latifolia.*
Yarrow, *Achillea millefolium.*
Couch or creeping wheat-grass, *Triticum repens.*

There are other plants besides these, found more or less in natural pastures, but, excepting the birdsfoot trefoil, *Lotus corniculatus*, Butter-cups, *Ranunculus acris*, and *Ranunculus repens*, Lamb's tongue or rib grass, *Plantago lanceolata*, Saintfoin, *Hedysarum onobrychis*, or *Onobrychis sativa*, Burnet, *Poterium sanguisorba*, and Sorrel dock, *Rumex acetosa*, they are either in such small proportions, or of such small comparative value, or noxious as weeds, that their exclusion from the permanent pasture seeds is proper. The saintfoin is properly a plant for separate cultivation, on particular descriptions of soils, chalky and loamy for instance; the rib-grass for poor elevated soils, where the superior grasses cannot attain perfection; the birdsfoot clover for poor descriptions of soils, as dry sands or dry clays; the others are cumberers of the soil, and occupy the place of the valuable grasses and clovers. It was before observed, that different varieties of soils naturally produce, and will only continue to maintain, under judicious management, definite proportions of such of the species of the essential grasses above enumerated as are adapted to the soil.

In siliceous, sandy soils, the *Festuca duriuscula, glabra, ovina, Agrostis vulgaris, tenuifolia, fascicularis, Holcus mollis, lanatus, Cynosurus cristatus*, and *Poa pratensis*, are in a larger proportion; while the *Festuca pratensis, Dactylis glomerata, Alopecurus pratensis, Poa trivialis, Phleum pratense major, Anthoxanthum odoratum, Holcus avenaceus*, and *Lolium perenne var.* are either altogether wanting, or in local spots, in small quantity. When the soil is *peaty*, but free of stagnant moisture by proper draining, and the *peat* of that description called *active* peat moss, the *Anthoxanthum odoratum, Dactylis glomerata, Festuca pratensis, Poa trivialis, Alopecurus pratensis, Cynosurus cristatus, Agrostis stolonifera var. latifolia*, and *Holcus avenaceus*, will be found to predominate, and with the *Lolium perenne var.* will continue productive or permanent, on soils of this nature, affording the most valuable crops, whether for hay or for depasturing, this soil is capable of carrying.

The most prevalent of the essential permanent pasture grasses, and which continue in the soil, or are permanent in calcareous or chalky lands, are *Dactylis glomerata,* Cocksfoot; *Festuca pratensis,* Meadow fescue; *Cynosurus cristatus,* Crested dogstail; *Festuca duriuscula,* Hard fescue; *Lolium perenne* var. Varieties of rye-grass; and *Bromus erectus,* Upright brome-grass.

When the texture of a soil is of a medium quality as to moisture and dryness, or consists of the best proportions of calcareous matter, or chalk, clay, siliceous sand, with decomposing and soluble animal and vegetable matters, all the most nutritive and productive, or essential permanent pasture grasses, succeed in perfection, and constitute the produce of the richest fattening pastures. For instance, a careful examination of the composition of the herbage of a pasture near Croft Church, Lincolnshire, which fattened through the summer one large ox, and from three to four sheep, per acre, was found to consist of, in the largest proportion, *Alopecurus pratensis, Dactylis glomerata, Festuca pratensis, Festuca duriuscula, Cynosurus cristatus, Phleum pratense major, Poa trivialis,* and *Lolium perenne var.* with a smaller proportion of the following species, but intimately combined with the former: *Avena flavescens, Holcus avenaceus, Agrostis stolonifera var. latifolia, Hordeum pratense, Vicia sepium, Anthoxanthum odoratum, Achillea millefolium, Trifolium repens, Trifolium pratense perenne, Agrostis palustris, Holcus lanatus* (in small quantity), *Poa pratensis;* in all twenty distinct species. In a turf, one foot square, of this pasture, the earth was carefully washed from the roots of herbage, and the individual plants of which it consisted separated, when their number amounted to one thousand and ninety. The intimate nature of this soil may be understood, by the following statement of the results of a chemical examination of it: 400 parts gave of,

	Parts.
Water of absorption, - - -	60
Fine sand, partly siliceous and partly aluminous, -	160
Decomposing vegetable matter, - -	40
Oxide of iron, - - - -	8
Carbonate of lime, or chalk, - - -	32
Soluble vegetable, animal and saline matters, -	6
Alumina, or pure matter of clay, - -	25
Silex, or pure earth of flints, - - -	65
Excess of moisture, and loss in collecting the different products,	4
	400

In the above soil, the proportion of calcareous matter or mild lime is considerable; the oxide of iron in a moderate quantity; the proportion of clay to siliceous impalpable earth is small, but the decomposing animal and vegetable matters are in a full proportion. The pasture on this soil, as before observed, fattened one bullock of heavy weight, and from three to four sheep per acre.

We shall give another example, from a soil of a different texture, situated in a local climate, differing as regards moisture.

400 parts of the soil of a rich natural pasture at Endsleigh, belonging to the Duke of Bedford, in Devonshire, and which fattened on an average, in the course of the season, one ox of one hundred and sixty stone, (Smithfield weight), and wintered two sheep per acre, gave of,

Water of absorption, - - -	55
Fine sand, partly siliceous and partly aluminous, -	148
Decomposing vegetable matter, - - -	38
Oxide of iron, - - - -	40
Carbonate of lime, or chalk, - - -	0
Soluble vegetable and saline matters, - -	6
Alumina, or pure matter of clay, - - -	34
Silex, or pure earth of flints, in an impalpable state, -	65
Loss of products in the analysis, - -	14
	400

The natural produce of this pasture consisted of *Festuca pratensis, Festuca duriuscula, Alopecurus pratensis, Dactylis glomerata, Bromus mollis, Poa trivialis, Cynosurus cristatus, Festuca rubra, Agrostis stolonifera var. latifolia, Lolium perenne var. Russellianum, L. p. var. compositum, Trifolium pratense perenne, Trifolium repens, Phleum pratense, Achillea millefolium, Anthoxanthum odoratum,* with a small portion of *Rumex acetosa, Bellis perennis,* and *Stellaria graminea.*

We shall now state the composition of sandy and of down pastures, *Festuca ovina, duriuscula, dumetorum, glauca, cambrica, bromoides, Agrostis canina, vulgaris, Avena pubescens, flavescens, Aira flexuosa, Alopecurus alpinus, Poa pratensis, compressa, rigida, Bromus mollis, Holcus mollis,* with more or less of *Dactylis glomerata, Lolium perenne, Cynosurus cristatus, Avena flavescens, Phleum pratense minor,* and *Bromus erectus.* Of the clover tribe, there are the *Trifolium pratense perenne, repens, Medicago lupulina, Lotus corniculatus,* and *Hedysarum onobrychis,* with numerous other species, but which occur either locally, or in too small a proportion to render them worthy of farther remark in these pages.

The grasses which compose the produce of the best water meadows, are all those which are found in the richest natural pastures already enumerated.

Pastures formed of rye-grass and clover, on a superior soil, afforded only 75 plants to each square foot. The superior rich permanent pasture, which was shewn to consist of twenty-two different species of plants, and the number of plants on a square foot proved to be 1090. The like space of an irrigated meadow of the best quality shewed a density of 1798 individual plants. To those who are accustomed to consider as necessary, only one or two species of grass, as rye-grass and clover, the fact of twenty different species, and that of one thousand individual plants of these, being the number and proportion required by nature to form a permanent pasture of the best quality, would scarcely appear credible unless they were thus proved, and easily, and which can, at any time, be demonstrated by any one, who will employ the simple means required for that purpose.

No. 2.—*The Natural Habits and comparative Value of different Species of Grasses.*

Anthoxanthum odoratum, Sweet-scented vernal grass. *Hort.*

G. W. 134*.—This is one of the earliest of the permanent pasture grasses, and there is no natural pasture of a feeding quality, that does not contain a proportion of this species. It comes into flower in April or early in May, according to the soil and local climate. The seed is ripe in the first or second week of June. The chemical examination of its nutritive matter, shews, that it does not abound in saccharine matter, but chiefly in mucilage; and the insoluble extract, is in a larger proportion than in some other grasses. Its merits however, in respect to early growth, its continuing to vegetate and throw up flowering stalks till the end of autumn, and its hardy and permanent nature, sufficiently uphold its claim to a place in the composition of all permanent pastures, particularly in every instance where the soil is of a medium quality as to moisture and dryness. The superior nutritive properties of the lattermath of this grass, are a great recommendation for the purpose of growing, the stalks being of but little utility, as they are generally left untouched by stock when there is a sufficiency of herbage. It is said to give to new mown hay, that delightful smell which is peculiar to it; and if it is not the sole cause of that pleasant scent, it is certainly more powerful, when the sweet scented vernal enters largely into the composition of the hay.

Dactylis glomerata, Round panicled cocksfoot grass. *Hort. G. W.* p. 136.—Although the cocksfoot grass seldom comes into flower until June, yet it is early in the produce of herbage, and it is superior to most other grasses in its reproductive powers, for it springs rapidly after being cropped, whether by the scythe or by stock. It is essential, to the reaping in full, all the superior advantages which this species of grass offers to the grazier, that it should be kept rather closely cropped, and never suffered to grow old and tufty, the quality of the herbage being much deteriorated by that circumstance; and that the nutritive matter afforded by the rank or old herbage of this grass, is nearly one half less than is contained in that of recent growth, and it is evidently less grateful to stock. In the pastures most celebrated for fattening and for keeping the largest quantity of stock in Devonshire, Lincolnshire, and in the vale of Aylesbury, cocksfoot is found in every instance to constitute a proportion of the herbage. In the most skilfully managed of these pastures, the foliage of cocksfoot grass is scarcely to be distinguished from that of the finer leaved grasses, prevalent in these celebrated pastures, as the *Alopecurus pratensis*, *Poa pratensis*, *Festuca pratensis*, *Cynosurus cristatus*, *Poa trivialis*, *Lolium perenne*, &c. The peculiar compressed channelled leaf, glaucous colour, and upright habit of growth of the cocksfoot, there alone distinguish it; but the tufty or hassocky and coarse appearance, which characterise it when cultivated by itself, or in an imperfect combination with other grasses, or under defective management

* *Hortus Gramineus Woburnensis*, in which this and all the essential permanent pasture grasses are figured and botanically described, with an account or statements of their comparative produce and nutritive powers, given in detail, from the result of many years' actual cultivation, to which the reader is referred for these particulars.

in depasturing, entirely disappear, when under judicious culture, such as that now alluded to.

Besides being one of the most valuable of the pasture grasses, cocksfoot is useful as a grass for the alternate husbandry, which will be reverted to, when discussing the plants adapted for that beneficial system. For the fullest demonstration of the utility of cocksfoot grass, the farmer is indebted to Mr Coke of Norfolk. The seed of cocksfoot is often defective, and a much larger measure of it is required, to produce a given number of plants, than that of rye-grass. Its value as an alternate husbandry plant is well known.

Alopecurus pratensis, Meadow foxtail-grass. *Hort. G. W.* p. 139. —In soils that are adapted to the habits of the meadow foxtail, individually considered, it is one of the most valuable of all the grasses, combining early growth, weight of produce, nutritive or fattening powers, and permanency. Every description of stock eat it with avidity. The culms are succulent, and are eaten in common with the herbage. This property of the culms, renders it peculiarly valuable, as a component part of hay. It comes early into flower, and the seed is in general perfected, and dispersed by the winds, before hay-cutting commences; yet notwithstanding this, the culms gain an accession of nutritive matter from the time of flowering until the seed be ripe, which is the case also with those of the *Anthoxanthum odoratum*. This is not the case with the culms of the later flowering grasses, but, on the contrary, the greater part afford the most nutritive matter at the period of, or just immediately after, flowering; a provision of Providence, in the laws which govern the natural economy of this tribe of plants, by which the early flowering of the culms of these two species, is rendered beneficial, or adds to their value as food when made into hay. It thrives well under irrigation, always, however, affecting the crowns of the ridges. The soils which are only adapted to the growth of this valuable grass, are those of an intermediate quality as to moisture and dryness. Wherever stagnant moisture exists, the meadow foxtail cannot be cultivated, nor will it continue or be productive on dry sandy soils. The seed also, is often defective, and occasionally requires a large measure to produce a sufficiency of plants; add to which, the natural consequence of this, a high price, and its merits for culture or farm practice is much lessened. It should have been observed, that it is rather slower of growth, from a seedling state to full maturity, than many other grasses, often requiring from two to four years, according to the circumstances of soil and local climate, and hence it is unfit for the purpose of the alternate husbandry.

It constitutes a part of the produce of all fattening pastures in Devonshire, Lincolnshire, Somersetshire and Wiltshire, which we have specially examined. We found it more prevalent in Mr Westcar's celebrated ox-pasture at Creslew, in the vale of Aylesbury, than in those of Devonshire and Lincolnshire. On the most careful estimate, it constituted at least one-eighth part of the produce.

Poa pratensis, Smooth stalked meadow-grass. *Hort. G. W.* p. 142. —Except on dry soils, this species of meadow grass is one of the least valuable. It has a strong creeping root, and when once in possession of the soil, it is difficult to extirpate. Like all creeping-rooted plants, it exhausts the soil more than the fibrous rooted. It is, however, of value in dry soils; it withstands drought; is early, and liked much by stock; but wherever it is intended at any future time to bring the land under the plough it should be avoided. It is one of the common couches of gardens, though seldom found in retentive clayey soils. Its produce is not great, particularly if hay be an object. The seeds ripen freely; they are connected together by a web-like substance; and when sown in this state, are apt to fall in clumps or masses. It is therefore necessary to prepare this seed for sowing, by mixing it well with other seeds of a firmer texture, as crested-dogstail, meadow-catstail, or any of the clovers, or mingling it with sharp sand.

The sweet-scented vernal grass, and the following species, are superior to the smooth-stalked meadow grass.

Poa trivialis, Rough-stalked meadow-grass. *Hort. G. W.* p. 146.—As this, and the preceding species of grass, are so similar in their general appearance, and so opposite in their agricultural qualities, it is of more than ordinary importance to the farmer, to distinguish accurately those two species, and we will therefore here mention the essential characters of distinction: *Panicle*, spreading; *spikelets*, four-flowered; *florets*, lanceolate, five-ribbed, connected by a web; *stipula*, short and obtuse; *stem* and *leaves*, smooth; *root*, creeping. Such are the distinctive characters of the smooth-stalked meadow-grass. The rough-stalked or present species, has the *panicle* rather spreading; *spikelets*, three-flowered; *florets*, lanceolate, five-ribbed, connected by a web; *stipula*, oblong; *stem* and *leaves*, rough to the touch when passed between the fingers backwards; *root*, perfectly fibrous. The most obvious distinctions, and which cannot fail, if strictly observed, are, *first*, the roughness of the stalk; *secondly*, the stipula, or small scale which is attached to the base of the leaf at its immediate union with the culm; this membrane is invariably oblong or tapering to a point in the rough-stalked meadow grass, while in the smooth-stalked species, the stipula is blunt or præmorse; *lastly*, the root of the latter is powerfully creeping or couch, while that of the former is strictly fibrous.

This is a succulent nutritive grass, on almost every kind of soil, excepting those of a dry, gravelly and sandy nature. It is however, not so hardy in exposed situations, as many other species. It is late in spring growth, while in sheltered situations, in rich soils, and in irrigated meadows, it springs early, and is much relished by stock. If in any pasture, there appears to be one part more closely cropped down than another, it is in almost every case found to be the *Poa trivialis*. Its culms are succulent, and are consumed in common with the leaves; hence the culms are seldom seen in a depastured field. It is a component in all fattening pastures, and constitutes one of the principal of those species called *sole* grasses. It is very nutritive. It is one of the species of which poultry and game are fond. It attains to perfection or inflorescence about the end of June, following, in this respect, the sweet vernal, meadow foxtail, and smooth stalked meadow grasses. The weight of its produce is not so great, as to rank it high for the intention of hay; its other properties enumerated, however, prove it to be an essential constituent of every fattening pasture. Its produce, when cultivated simply by itself, is always less, sometimes descending to one-half of what it produces when combined with other grasses; hence it is, that the valuable property of forming a close turf among shading, or taller and heavier grasses, which of themselves never form a dense bottom, is preeminent in this species. In fields that are constantly mown, this grass disappears altogether, though the soil be adapted to its growth; and in the opposite practice, on a similar soil, where close depasturing, without any intervening crop of hay being taken, it frequently spreads beyond its just space, and occupies too large a proportion of the surface of the field. The quantity of seed required for an acre, varies from one to four pounds, (with the just proportions of the other grasses,) according to the nature of the soil and objects of depasturing, or hay.

Festuca pratensis, Meadow fescue. *Hort. G. W.* p. 149.—It is of much importance to the cultivator, to distinguish this grass from some others, with which it is not unfrequently confounded; for we have known the turfy hair grass, *Aira cæspitosa*, the Hard fescue, *Festuca duriuscula*, Tall fescue, *Festuca elatior*, and Perennial rye grass, *Lolium perenne*, and several others of equally different properties, mistaken for this valuable grass. Its essential specific characters of distinction are; *panicle*, nearly upright, branched, spreading, turned to one side; *spikelets*, linear, compressed; *florets*, numerous, cylindrical, obscurely ribbed; *nectary*, four cleft; *root*, fibrous. All these grasses now mentioned, except *Festuca elatior*, as being not unfrequently mistaken for the meadow fescue, are so strikingly dissimilar to it in external characters, that the above description, with a little attention in using it, will readily identify the meadow fescue, which is distinguished from the Festuca elatior, by having only half the height, the leaves only half the breadth, the panicle shorter, and containing only half the number of flowers *.

This is one of the most valuable pasture grasses, being very productive. There is no ox-fattening pasture found without an admixture of this grass in its composition. It comes into flower about three weeks later than the meadow foxtail, and succeeds that grass in giving bulk to the produce. In the vale of Aylesbury, it constitutes a considerable portion of the most valuable and fattening pastures of that rich grazing district. It is a valuable ingredient in irrigated meadows; it makes excellent hay; and though a large plant, approaching the confines of what is termed in grasses coarseness, its herbage is succulent and highly nutritive, and so much liked by stock, that it is seldom seen in tufts, but eaten down level with the finer leaved species, with which it is usually combined. It does not arrive so soon to perfection from seed, as to offer advantages for using it in the alternate husbandry. It flowers in June, and ripens the seed about the beginning of August. The soils which it affects most are deep loams, and well-drained clays. It will not thrive or continue permanent, where stagnant moisture exists, or in dry sandy soils.

* For a figure of the whole plant, and of the seed, see Hortus Gramineus Woburnensis, 3d edition, pp. 24. 149.

Cynosurus cristatus, Crested-dogstail. *Hort. G. W.*—This is a very prevalent grass in pastures of every description, but it is chiefly valuable, for forming a sole or bottom, in clayey or moist, (not sour or undrained land) surface soils. On sandy soils, or those which are very dry, its produce is very inconsiderable, like the rough-stalked meadow-grass before mentioned. There has been some difference of opinion respecting the qualities of this grass. It certainly possesses no merits for the alternate husbandry, and the growth of its herbage is slow and light. It is notwithstanding of essential use, as one of the sole grasses, and a perfect pasture cannot be made, without a portion of it entering into the composition of the sward. The herbage is nutritive, and much liked by sheep and deer. In all the most celebrated pastures we have examined, it constituted a considerable proportion of the different species combined in them. The stalks are left untouched by cattle, and the seeds, adhering to the husks, afford a supply of food to birds in winter; the culms are wiry, and stand upright in snow. It flowers in June, and ripens the seed towards the end of July.

Holcus avenaceus, Tall oat-like soft-grass. *Hort. G. W.* p. 169.—There are two varieties of this grass, one with congeries of bulbous roots, which are very troublesome in arable land, and constitute a species of couch; the other has few of these roots, and oftentimes they are altogether wanting, the fibrous form of the root taking the place of the bulbous. This is one of the tallest of the permanent pasture grasses. It is most frequent in loams and clays, and is always present in the most productive pastures, though in a smaller proportion, than that in which the essential grasses are in general found. It is eaten by stock in common with the other grasses. The weight of produce is comparatively very great, but it is deficient in the quantity of nutritive matter which it affords. It contains a larger proportion of bitter extractive and saline matter than most other grasses, and it is highly probable, that this property renders it indirectly nutritive, by assisting or modifying the functions of digestion. It should enter but sparingly into the mixture of seeds for a permanent pasture.

Poa nemoralis, var. angustifolia, Narrow-leaved wood meadow-grass. *Hort. G. W.* p. 184.—This grass springs early, and the herbage is remarkably fine and succulent, and highly nutritive. It is much earlier and productive of spring herbage than the *Poa trivialis*, before described; and it resembles this species in having its most valuable produce in spring. In summer, it is liable to be attacked by the rust disease. It is much relished by stock; and where the soil is not too dry, it ought to find a place in the composition of permanent pastures.

Poa angustifolia, Narrow-leaved meadow-grass. *Hort. G. W.* p. 184.—This species is nearly allied to the smooth-stalked meadow-grass, and wherever that is proper to be sown, this is to be highly preferred, as it is productive, and early in its produce. The spring growth is in quantity nearly double that of the *Poa pratensis*, or *Poa trivialis*, on any given quantity of ground. It affords also more nutritive matter, and possesses greater reproductive power after being cropped. Its having a creeping root demands attention, so that it may be kept out of any combination of grasses intended for permanent pasture on soils intended to be again brought under tillage. There is no species of the proper pasture grasses more permanent than the narrow-leaved *poa*.

Poa fertilis, Fertile meadow grass, *Hort. G. W.* p. 186.—Is a native of Germany, and possesses considerable merits. As regards early growth, it ranks with the best of the spring productive grasses, and the herbage is equal, if not in some cases superior, in fattening properties. The habit of sending up a succession of flowering culms during the season is very powerful in this species; hence it is better adapted for hay than for depasturing. A soil of a medium quality, as to moisture and dryness, inclining to siliceous sand, is what it appears most to affect. It flowers in the beginning of July, and the seed is ripe towards the end of the month.

Bromus arvensis, Field brome-grass. *Hort. G. W.* p. 173.

Bromus mollis, Soft brome-grass. *Hort. G. W.* p. 176.

These two species of brome-grass, too common in many pastures, particularly the latter, are strictly annual plants, and, like corn, produce much seed and little available herbage. The former is much less unprofitable than the latter, for its roots do not penetrate deep; the seed is lighter, and does not exhaust the soil in an equal degree to the former. It is also hardy. The seeds being shed *early* in the season, the plants appear strong by the time winter begins, and during winter, and until the culms begin to rise in the spring, and accordingly afford a portion of the keep supplied by the pasture in which it may be. The soft brome-grass, however, possesses these properties in so slight a degree, that it cannot be considered otherwise that as a cumberer of the soil, occupying the place of more profitable plants. Being strictly annual, the easiest mode of eradicating them is by preventing them from producing seed. This, pursued for two seasons, would clear the field of these unprofitable plants. When they get into a pasture that is mown for hay, whatever seed is not shed before reaping the crop is carried with the hay, and returned to the field with the manure, so that their propagation is doubly insured *.

Festuca loliacea, Darnel-like fescue. *Hort. G. W.* p. 178.—This singular species of grass, which is believed to be a hybrid production between the rye-grass and meadow fescue, as it divides the character of both in its own, never produces any perfect seed. It is strictly perennial, and possesses all the good qualities of rye-grass, and some of those of the meadow fescue, but none of the defects as regards early growth, produce and nutritive properties. In a piece of meadow ground on the Trent, we found it to constitute the principal produce of the pasture. The defect of the seed, renders its merits unavailable for extensive farm practice.

Festuca duriuscula, Hard fescue-grass. *Hort. G. W.* p. 155.

Festuca cambrica, Welsh fescue. *Hort. G. W.* p. 157.

Festuca ovina hordiiformis, Long-awned sheep's fescue. *Hort. G. W.* p. 159.

Festuca glabra, Smooth fescue. *Hort. G. W.* p. 180.

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* Hence the *Bromus mollis*, is universally prevalent, in the pastures and hay fields near London.

These four species of grass are very similar in their habits, but differ as to their comparative value for agricultural purposes. One valuable property is common to all the three, the power of withstanding the bad effects of drought. In this respect they are superior to any of the grasses before named, and being nutritive, succulent, and forming a close turf, one or other of them is essential as an ingredient in the composition of a pasture of the best quality. The first mentioned, is common to all rich natural pastures, and irrigated meadows of the best quality. It keeps its place in rich soils, in company with grasses of large growth, where it assists greatly in forming a close bottom; but, on sandy soils and down lands, it is of very great value, as it thrives well in such situations, and is less injured by the extreme of hot dry weather than most other grasses, and in these situations it is one of the principal grasses. The Welsh fescue is inferior to the hard fescue, but is a good substitute for it, when the seed can be more readily procured, or when the seed of the former is not to be obtained. The long-awned sheep's fescue is adapted for dry sandy soils; its produce is considerable, compared with that of other fine leaved or down grasses; and could the seed be obtained in sufficient quantity, and at a cost proportionably low for farm practice, it would be preferable to the *Festuca duriuscula* on dry soils, and at least of double the value of the sheep's fescue on its own peculiar soil.

Although the smooth leaved fescue cannot be recommended in preference to the hard * fescue, yet for soils of a medium quality as to moisture and dryness, it will be found the best substitute. There is another species, *Festuca rubra*, which belongs to this group of the fine leaved fescues, with powerfully creeping roots. It is chiefly confined to the blowing sands of the sea coast, and in that situation, it is highly useful, in arresting the dispersion of the sand by the wind, and consequently of any inroad by the sea †.

Avena flavescens, *H. G. W.* p. 161, Golden oat-grass, Yellow oat-grass.—This is a very common pasture-grass in all loamy, calcareous, and drained clayey soils. It prevails in all the pastures near London. On very dry soils, its produce is worthless, but, when combined with the sweet scented vernal crested-dogstail, and meadow barley grass, its produce is considerable. Its nutritive matter contains more bitter extractive and saline matters, than is afforded by those grasses with which it is usually combined. Sheep and deer eat it in common with the produce of those grasses. It flowers in July, and the seed is ripe in August.

Holcus lanatus, *H. G. W.* p. 163, Woolly soft-grass, Yorkshire fog, Yorkshire whites.—The great objections to this grass are its light woolly texture, affording little nourishment in proportion to the bulk of its produce, being disliked by stock when in a green or hay state,

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* The name *hard* or *hardish*, as applied to this species of grass, is not very appropriate, inasmuch as its foliage is soft and succulent. The circumstance of its being often found on hard dry soils, may probably have procured it the designation.

† The *Poa maritima*, *Arundo arenaria*, and *Elymus arenarius*, are generally found in union with the *Festuca rubra*, constituting the foundation of the barrier.

and its property of overspreading the soil, to the exclusion of more valuable grasses. The seed ripens in abundance, and being light, is easily dispersed by the winds. It vegetates readily, and may be obtained at a lower price than the seed of any other grass. It is late in spring growth; it flowers and ripens the seed in July. It is so much disliked by cattle, that it may be observed in pastures, spreading out its long broad leaves on the surface, uncropped, while the herbage of the surrounding grasses are browsed to the roots. On all soils of a good quality, the question is how to get rid of it. Close stocking, and never suffering the culms to ripen seed, will keep it under, and in time diminish its quantity; but the only effectual remedy is, to plough up the sward, take a course of cleaning crops, and then reconvert the soil to improved pasture, by sowing the superior pasture grasses in such proportions as are suited to the soil. On poor elevated soils however, where the finer grasses will not thrive, a proportion of this species may be very useful, but it should be cautiously used.

There is another species, the *Holcus mollis*, *Hort. G. W.* p. 165, which is very similar to the above in the external habits of growth, but which is still more objectionable, owing to its having a powerfully creeping root, and which, on light sandy soils, constitutes the most noxious variety of couch grass. There is no grass, when once in possession of the soil, with more difficulty extirpated than this one.

Poa nervata, *H. G. W.* p. 192, Nerved meadow-grass.—This species is a native of North America. It is not so productive as some of the essential grasses, though superior in that respect to others. It is distinguished for being very nutritive. It affects rather a moist soil that is perfectly drained. On sandy soils that are dry, or what is called subject to *burn*, it does not succeed. It constitutes a valuable ingredient in the composition of pastures on soils of the first-mentioned description. It is very hardy, and the herbage rich and succulent. It flowers about the first week in June, and ripens the seed in July.

Phleum pratense, *var. major*, Larger meadow catstail, Timothy grass. *H. G. W.* p. 195.—The merits of the Timothy, or larger meadow catstail grass, is so well known to farmers, that little regarding it may be required to be stated here. It enters, as an essential constituent, into every fattening pasture of the first class. It is nutritive and productive, and although not an early flowering grass, yet the spring growth of herbage which it affords, is not inconsiderable. The seed is in general good, and it vegetates freely. It should be cut, if intended for hay, while it is in flower, otherwise the produce becomes coarse. The hay made of this grass is very nutritive, and considered excellent food for horses. It is employed with advantage in the alternate husbandry, combined with rye-grass and cocksfoot, where a two years' ley is practised, or necessary in the course. There is a variety of this species of a very inferior value; it is called *Phleum pratense*, *var. minor*, and should be carefully guarded against. It is more common, particularly on all clayey pastures, than the true species. It is smaller in every respect, with a wiry straw, and hard unnutritive herbage. The seeds are much alike, except that the seed of the inferior variety is considerably smaller.

Bromus erectus, Upright brome grass. *Hort. G. W.* p. 205.—This grass is chiefly confined to chalky soils, although occasionally found on other sorts. It is one of the larger growing grasses on the soil it affects, and so far is valuable as an ingredient in pastures of that description. It is inferior in nutritive powers to several others. It flowers rather early, but the growth of foliage is comparatively late. It should therefore be excluded from pasture land of the best quality, and only admitted into pastures on chalky soils. Pheasants are very fond of the seed; they frequently pick off the spikelets before the seed be perfected.

Briza media, H. G. W. p. 206, Quaking grass, Ladies' tresses.—This grass is chiefly confined to poor clays, and the results of a separate cultivation of it prove, that it does not possess merits sufficient to entitle it to a place, in the composition of pastures of the best quality, but in secondary soils it is of value.

Lolium perenne var. H. G. W. p. 211, 217. Different varieties of rye-grass.—There has been much difference of opinion respecting the merits and comparative value of rye-grass. It produces an abundance of seed, which is easily collected, and which vegetates readily on most kinds of soil. It soon arrives at perfection, and produces, in its first years of growth, a good supply of early herbage, which is much liked by cattle. These merits have no doubt upheld it till the present day in practice, as a favourite grass with farmers, and doubtless, for a one year's ley, as in the alternate husbandry, it will continue to keep its place. But for the purposes of permanent pasture, considered by itself, rye-grass is unfit; although in a certain proportion, as an ingredient in a mixture of various grasses, it is essential. The lattermath of rye-grass is very inconsiderable, and the plant impoverishes the soil in a high degree, if the culms, which are invariably left untouched by cattle, are not cut before the seed advances towards perfection. When this is neglected, the field, after midsummer, assumes the appearance of a brown surface of withered straws. When a field is laid down to grass, with rye-grass and clovers only, the first and second year of the pasture is satisfactory, in some degree, as to spring feed, but the summer and after grass keep is very deficient, and, in the following years, these grasses disappear; and whatever grasses may be in the soil naturally, or brought on by manure, whether good or bad, they take possession of the soil, and disappointment and loss follow, more or less, according to circumstances. There are several varieties of rye-grass; the most important for permanent pasture are Pacey's, Russell's, Whitworth's and Stickney's. The first is in most general use, being adapted to most kinds of soil; the second is best adapted for rich deep lands; it produces a large proportion of foliage, and comparatively less culms or straw; Stickney's, the next in order, has properties resembling this, but in an inferior degree; and the last-mentioned, has finer foliage than the others, and is best adapted for culture on high or wold lands. It is difficult to procure genuine seeds of the three last-mentioned kinds.

Agrostis stolonifera, var. latifolia, H. G. W. p. 225, Broad-leaved creeping bent or fiorin.—This grass spreads out on the surface of the soil, taking root at the joints in the manner of the strawberry plant, which unfits it for depasturing when cultivated by itself; but this objection is removed by combining it with other grasses, in the manner in which it is found in the best permanent pastures. Its chief advantage, in permanent pasture, is its late growth, not, however, as regards aftermath produce or foliage, but in the substantial part of branches or stolons, as well as of leaves, at a season of the year, when the latter are only afforded by grasses generally. There has been much prejudice existing against the different species of agrostis in general, but let the proprietor of any rich productive pasture divest a part of it entirely of this grass, and the value of the plant will be demonstrated, in the loss of late and early keep. There are several very inferior varieties, some of which are noxious as weeds, and should be carefully distinguished from this species, which is the only one to be cultivated. It forms an essential ingredient in every pasture of the best quality.

The different clover plants, essential to the formation of a pasture of the best quality, are the white, or Dutch clover, the perennial red clover, or cow grass, to which ought to be added, the creeping vetch, or *vicia sepium.*

The white or Dutch clover, *trifolium repens,* is an essential constituent of every pasture of value, from the dry or sandy, to the rich and moist. The perennial red clover is less common, but it is a highly valuable plant in all loamy soils in particular. It is very difficult to get genuine seed of this plant. There are two species of red clover that pass by the name of cow-grass, viz. *Trifolium pratense, var. perenne,* which is the cow-grass of the seed shops, and the *Trifolium medium, Hor. G. W.* p. 218, which is the cow-grass and marl-grass of botanical writers. We believe the seed of the latter has never been brought to market, or used in practical husbandry. The plant has a strong creeping root, and is perennial in the utmost sense of the word.

The *Vicia sepium, H. G. W.* p. 209, is one of the most nutritive of pasture plants. It constitutes a most valuable ingredient, in pastures where the soil is of a medium quality as to moisture and dryness. The seed is very difficult to collect. The plant comes early into flower, and continues to flower through the summer. It ripens therefore irregularly, and the pods are apt to open by the heat of the sun, and scatter out the seed.

The Yarrow, *Achillea millefolium,* contains saline and bitter extractive matters in a degree, which renders the herbage of it a wholesome ingredient in pastures, and a little of it therefore, should be introduced, when a new permanent pasture is made. A few ounces of the seed will be sufficient for an acre.

No. III.—*The mode of Culture to be pursued in forming a permanent Pasture of the best quality.*

In the preceding section, an account is given, of the natural habits, properties, and comparative value, of the proper grasses and clovers, which constitute the produce of the richest natural pastures and meadows. To have entered into more minute details, of the comparative differences that exist, between the different species of grasses, as regards early growth of foliage or of culms, superior weight of produce, season of the year when that produce is available, or fit for use, permanency, reproductive powers, late growth, and nutritive powers, would be inconsistent with the design of this work. A perusal of those particulars which we have stated, may be sufficient to prove, that to obtain a permanent pasture of the best quality, equal to the best natural pasture on a soil of the like quality, not two or three species, but many different species of grasses are essential.

The number of plants on a given space that are found in the richest and most productive natural pastures, has been mentioned. The number of seeds contained in any given weight or measure of these seeds, will shew the number of plants that ought to be produced by sowing certain quantities per acre. These calculations have been made *, and the following proportions of the essential grasses are calculated for six acres of a soil of the best quality:

Dactylis glomerata, Cocksfoot, - - -	2 bushels
Festuca pratensis, Meadow fescue, - -	2 do.
Alopecurus pratensis, Meadow foxtail, - -	2 do.
Poa trivialis, Rough stalked meadow-grass, - -	2 do.
Holcus avenaceus, Tall oat-like soft-grass, - -	½ do.
Phleum pratense major, Larger meadow catstail or Timothy, - - - - - -	15 lbs.
Festuca duriuscula, Hard fescue, - - -	1 bushel
Cynosurus cristatus, Crested dogstail, - - -	1 do.
Poa nervata, Nerved meadow-grass, - - -	½ do.
Poa nemoralis, *var. angustifolia*, Narrow-leaved wood meadow-grass, - - - - - -	1 do.
Poa angustifolia, Narrow-leaved meadow-grass, -	¼ do.
Agrostis stolonifera, *var. latifolia*, Broad-leaved bent or fiorin, - - - - - - - -	½ do.
Lolium perenne var., Best variety of perennial rye-grass,	1 do.
Anthoxanthum odoratum, Sweet-scented vernal-grass,	¼ do.
Trifolium repens, White or Dutch clover, - -	15 lbs.
Trifolium pratense perenne, Perennial red clover, or Cow-grass of the shops, - - - - -	½ bushel
Vicia sepium, Creeping vetch, - - - -	½ do.
Achillea millefolium, Yarrow, - - - - -	4 lbs.

amounting to about 15 bushels for six acres. The seeds of the different grasses vary much in size, and consequently in the number of plants which any given measure will afford when sown; hence it is, that when the smaller seeded grasses prevail in the mixture, the measure of seed per acre, is less, than when the larger seeded grasses predominate. To state the various combinations of grasses, required for all the different varieties of soil, without minute details of the chemical properties and constitution of such soils, so that they could be always identified, without fear of mistaking one for another, would be more likely to lead to error, than to guide with certainty, the practical operations of the farmer. We shall therefore only add another example, of a mixture for a light sandy soil of inferior quality.

* See Hortus Gramineus Woburnensis.

		Peck per acre.
Dactylis glomerata,	Cocksfoot,	$3\frac{1}{2}$
Lolium perenne var.	Best variety of perennial rye-grass,	$3\frac{1}{2}$
Festuca duriuscula,	Hard fescue, } -	$2\frac{1}{2}$
Festuca glabra,	Smooth fescue, }	
Festuca hordiiformis,	Long-awned sheep fescue, -	$\frac{1}{4}$
Phleum pratense,	Meadow catstail, - -	$\frac{1}{4}$
Anthoxanthum odoratum,	Sweet vernal, - -	$\frac{1}{2}$
Agrostis stolonifera,	Fiorin, - - -	$\frac{1}{4}$
Avena flavescens,	Golden oat-grass, - -	$\frac{1}{2}$
Cynosurus cristatus,	Crested dogstail, - -	$\frac{1}{2}$
Trifolium repens,	White clover, - -	$\frac{1}{4}$
Medicago lupulina,	Yellow clover or nonsuch. -	$\frac{1}{4}$
Trifolium minus,	Smaller flowered clover, -	$\frac{1}{4}$

Total quantity about three bushels and one peck per acre.

The great importance, of having all the different species intimately mixed or combined, so that not two individual plants of the same species should stand together, or be without an intervening plant of a different species, has been alluded to. This intention is greatly assisted, in preparing the seeds for sowing, by first mixing the larger and lighter seeds together, sowing the mixture as regularly as possible over the surface, and then combining the smaller and heavier seeds together, and sowing them in like manner equally over the surface. Thus the division of the seeds into two separate mixtures, and giving each a separate cast, will insure the equal and regular distribution of all the different species over the whole surface. But however judiciously the different grasses may be selected for the soil, the exact proportions of each used, and the process of sowing them accurately executed, yet, notwithstanding all that, should the soil be not properly prepared for the reception of the seeds, the object will be as far from being gained, as would a crop of turnips or of wheat be secured, by the careful selection of the seed merely, and neglecting the proper preparation of the soil for the crop. The soil should be made perfectly clean of root, as well as of seed or annual weeds. It should be in good heart, and if not so, manure should be applied in sufficient quantity. Should there be the least suspicion or danger of stagnant moisture, ample draining ought to be effected. The tilth should be fine. The seeds should be covered very slightly, that is, sufficiently to prevent the rain from washing up the seeds, and exposing them to the sun and air, and to the depredation of birds. The slight mixture requires rather more covering than the smaller and heavier seeds. The season for sowing the seeds of the perennial grasses depends much on the nature of the soil, and of the local climate of the site *. In warm sandy soils, and where the local climate is favourable, autumnal sowing is to

* In returning a large space of ground in Thirlstane Park, to improved permanent pasture, circumstances prevented the Earl of Lauderdale, from having the seeds sown until late in June, and yet a crop of hay, obtained the same season, was estimated at one and a half tons per acre. The weather, however, was moist, and the preparation of the soil, and operation of culture, were effected in the most skilful manner. The want of moisture is what renders the summer months ungenial for grass seeds.

be preferred, because the seeding grasses, if sown in the beginning of August, will have rooted sufficiently, to be able to withstand the effects of the winter's frosts, damps and *worm-casts*. On the contrary, when the soil is cold, damp or clayey, spring sowing, as in April, is greatly to be preferred in such soils. The clover, and several of the smaller or *sole* grasses, are very apt to perish altogether, when in a seedling state, in damp winters, or where there happen to be frequent alternations of frost and rain. If a pasture of the best quality be an object, and to obtain it in the shortest space of time, or in fact, the same season of sowing, any admixture of corn or grain crops should not be sown with the grass seeds, but they should be sown alone, as above mentioned. If sown in April, the pasture will be ready for the reception of young stock, in the course of three months from the time of sowing.

For light sandy soils or sandy loams, a green crop fed off, is the very best precursor to the permanent pasture grass seeds. Where the soil is stiff and clayey, and where it contains a good proportion of carbonate of lime, paring and burning for the green fallow crop, to be fed off, is a most excellent preparation *.

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* It may not be uninteresting to select, from among the numerous successful trials that have been made on a large scale, on different soils and local climates, to form a perfect permanent pasture in the space of two seasons, an example of each kind of soil.

Strong *tenacious clay* on Blackrock farm, belonging to W. Rickford, Esq. M. P. situated near Aylesbury in Buckinghamshire, and consisting of 28 acres, was sown down without corn, late in the spring of 1825, and the success was most complete. It is one of the best dairy pastures, on the like nature of soil, in that district. Four years afterwards, Mr Rickford was so satisfied with the results, that he laid down another field of the same nature of soil, which has been attended with equally favourable results. It is proper to add, that the most skilful attention was paid to the preparation of the soil, the selection, and the culture of the seeds.

A large field of a *sandy loam*, on Speedwell farm, belonging to the Duke of Bedford, was sown down, according to the new method, in 1817. A space was sown according to the old method, for comparison. The combination of grasses, imitative of the natural pasture, produced a perfect sward, which has continued permanent, while the space sown down according to the old system, had to be renovated the second year from sowing.

On *flat low lying surface, partly alluvial and partly peaty*, which had been supposed incapable of being returned to rich valuable pasture by art, it has been effected in one season, on a farm which then belonged to the late Emily, Marchioness of Londonderry, North Cray, Kent, and rendered equal to the richest natural pastures in the neighbourhood.

Of *calcareous gravelly soils*, that have been converted into permanent pasture, rich and productive in the space of two seasons, those of Mr Crawley's estate at Stockwood, in the southern part of Bedfordshire, may be mentioned.

Strong tenacious clay, differing from that before described, on an elevated or rising site, has been formed into a superior permanent pasture in one season. As an example may be quoted, a large field of that nature, laid down to grass by Mr Whitehouse of Studby, Warwickshire. Of the *light gravelly* and *sandy soils*, where these seeds have been employed with perfect success, in converting them to improved permanent pasture, may be mentioned, those belonging to Mr Stansfield of Wakefield, Yorkshire; Mr Beaumont Swete's, Oxton, Exeter; the Duke of Bedford's in Devonshire, under the direction of Mr Wilson; Mr R. Bicknell's, Fair Mile farm, Surrey; Mr Cope's, Shrewsbury-House, Kent, &c.

No. VIII.

ON THE USES OF SALT IN AGRICULTURE.

There is probably no substance, that could, in so many various respects be rendered so useful to agriculture, *as salt.* 1. It operates as a manure to arable land;—2. It may be of use in promoting the fertility of waste land;—3. It is an effectual remedy against the smut;—4. It preserves the seed, when sown, from vermin;—5. It promotes the vegetation of oily seeds;—6. It increases the produce of pasture land, and meadows;—7. It improves the quality of hay;—8. It renders coarse food more nourishing, and moist food less injurious, to cattle, and horses;—9. It preserves stock from disease, and improves their condition;—and, 10. It has a tendency to prevent the rust or blight in wheat.

1. *On Salt as a Manure to Arable Land.*—Though salt, if employed in large quantities, in its natural state, is hostile to vegetation, yet it operates advantageously, in various ways, when judiciously applied to arable land. In large quantities, it has a tendency, like every other excessive stimulus, to disorganize and destroy the vegetable substances with which it comes in contact; but in *moderate quantities*, it promotes the growth of vegetables, by enabling them to take up more nutriment, in a given space of time, and to perform their circulations and secretions with greater energy *.

The following are modes, in which it has been successfully made use of for the improvement of arable land.

1. In preparing the soil, *under the fallow process*, it is recommended, to sow from thirty to forty bushels of salt per statute acre, for the purpose of destroying the roots and insects in the soil, and breaking all the tough and adhesive clods which are found to be so troublesome in working the ground. This should be done in autumn, some

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On moor and gravelly soils of high elevation, superior permanent pasture has been formed, and improved, where the new practice has been adopted, as on the estate of Mr Brown of Auchenlochan, Lesmahagow, Lanarkshire, and Lord Ruthven in Perthshire; and these trials were made on a large scale, under circumstances very unpropitious, the season being hot and dry, and consequently injurious to the vegetation of the seeds and to the progress of the seedling grasses. The above instances are selected, from numerous others equally worthy of being quoted, with the view of pointing out the fact, that success in this branch of practical husbandry, does not depend on the nature of the soil, but that, on different and opposite soils, success is equally certain, provided the proper mode of culture be pursued, and genuine seeds used; for unless the seeds be pure, and genuine to the species, it is necessary to add here, that the result will be unsatisfactory, if not altogether a failure, as may happen, in the well-known culture of the turnip or the wheat crop.

* Darwin's Phytologia, p. 336; Cheshire Report, p. 240. As an article of food, salt can never promote the growth of vegetable substances, the marine alone excepted, but as *a chemical agent*, it may certainly be of use, by either destroying, or facilitating the decomposition of animal and vegetable substances. By its tendency to deliquescence also, it may promote the fertility of the soil. Hayward, p. 101.

time before the land is ploughed. The salt being thoroughly incorporated with the soil, during the spring and summer following, the strength of the salt would be so much reduced, when the seed is sown, that instead of injuring, it will promote vegetation; and the lands, it is said, will be found to produce a crop, superior to those under any other mode of cultivation, the advantage of which will be experienced for several succeeding years *.

It would be extremely important, to compare the produce and expense of a fallow, treated in this manner, or manured with lime.

Salt has likewise been advantageously applied *to crops*. R. Legrand, Esq. tried it twice on a barley tilth, sowing the salt at the rate of sixteen bushels per acre, immediately after the crop was covered by the harrow. The verdure in spring, owing in part perhaps, to its producing moisture, exceeded any thing he had ever seen, and the ripened appearance was whiter, by many shades, than he had ever beheld †. Mr Hollinshead also, recommends sowing sixteen bushels of salt per acre, on a crop of potatoes, as soon as they are covered with earth; and he maintains, that by the adoption of that system, alternate crops of wheat and potatoes, might be permanently produced on the same soil ‡. These are modes of application, however, the utility of which ought to be tried by repeated experiments, before they can be confidently relied on.

It has been proved by Pringle and Macbride, that though salt will, in large quantities, prevent putrefaction, owing to its antiseptic properties, yet that it has an evident tendency to promote the process, when used in small quantities. Hence the advantage of mixing it in moderate quantities with farm-yard dung §, and other animal and vegetable substances.

An experiment was tried in Cheshire, of mixing grass roots, and other rubbish harrowed off the land, with foul salt; it was then incorporated with other manures, and the effects of this compost, on a crop of barley and grass seeds, is said greatly to have exceeded the most sanguine expectations that had been formed of it ‖.

Salt, when applied in composts, is said to have been found a more beneficial manure even than lime. A farmer mixed up a quantity of refuse salt, with the earth taken out of water furrows, and another portion of the same earth with lime. Of the two, the vegetation of that part of the field, which had *the salt compost* laid upon it, was by far the healthiest and most vigorous ¶.

In those parts of Cornwall, where the pilchard fisheries prevail, considerable quantities of old or condemned salt **, are used as a ma-

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* Hollinshead on the Importance of Salt as a Manure, second edition, p. 17. It is said that Mr Hollinshead devoted above twenty years of his life, to a scientific and practical inquiry into the uses of salt as a manure.—Sir Thomas Bernard's Tract on Salt, p. 279.

† Hollinshead, 2d edit. p. 12. ‡ Ditto, p. 19.

§ It may be advantageously strewed over farm-yard dung, when carried to the field.

‖ Cheshire Report, p. 237. ¶ Ditto, p. 237.

** Sir Humphry Davy (Lectures, 4to edit. p. 295), states, that refuse salt, nure, mixed in compost with earth, scrapings of roads, broken fish, sea sand and stable dung. The quantity of salt allotted to an acre, thus mixed in compost, is about a ton, which may cost about ten shillings. The broken fish is considered to be the most valuable article, but the salt is accounted friendly to vegetation, in cases where it is thus used in a mild and modified state.

The most extraordinary circumstance, connected with the effects of salt on vegetation, takes place in the southern provinces of France. The surface of the ground on the sea-coast of those provinces, contains a quantity of saline particles. When the season arrives for cultivating that species of soil, the farmers find it necessary to sow, not only wheat, but a plant called *salicor*, or *kali*, which produces barilla. If a great quantity of rain falls from the month of April to that of June, the wheat prospers, the salt being washed down below the roots of the plants, leaving the saline particles remaining near the surface of the soil, in that state of equilibrium which is favourable to the vegetation of grain. On the other hand, if the weather is dry, and the salt remains near the surface, the *salicor* prospers, for it demands a great quantity of salt for its vegetation. Thus, when the grain prospers, the salicor perishes, and when it succeeds, the grain is destroyed *.

2. *Of Salt, as promoting the Fertility of Waste Land.*—Having, at the desire of the Board of Agriculture, written to an intelligent correspondent in the Netherlands (M. Gillet of Brussels), to know, whether the farmers there, had derived any agricultural advantages from the use of salt, I received in return, the following information, which explains how salt, when judiciously applied in compost, may promote the improvement of waste lands.

The Abbey of St Pierre, at Ghent, before the Revolution, broke up about 150 English acres (fifty Flemish bonniers) of moor-land, near Oudenarde, and in order to procure manure, they adopted the plan of collecting all the heath-clods or lumps which the soil produced, into piles, and intermixed them with strata of salt. These piles were turned over once a year, for three years successively, and were then spread upon the land, which, by means of that manure, produced good crops for two years. The land being let to farmers, the plan of using salt was given up, and the soil becoming unproductive, was planted with brushwood or coppice. It was then however ascertained, that salt, thus applied, dissolved the coarse heathy substances to be found in such soils, and converted them into manure.

(which, however, likewise contains some of the oil and exuviæ of fish), has long been known *as an admirable manure*, in Cornwall.

* "*Si le blé à bien vegeté, le salicor perit ; et il prospere, lorsque le blé est detruit.*"—Traité sur la Culture des Grains, tome premier, p. 268. It is probable that the *salicor* would grow in this country, if a quantity of salt were sown with it.

It would be important to know if the crop of wheat, when it does succeed, is ever affected by the rust, in a soil so much impregnated with saline particles.

The effect of salt, applied in the same way *to peat,* in alternate strata, is a most important subject of experiment, which, if successful, would greatly promote the improvement of waste lands. It would probably act more rapidly on peat than on heath, and would thence furnish an immediate manure for a crop of turnips, so well calculated for bringing such soils into a state of fertility.

3. *It is an effectual Remedy against Smut.*—It is well known that seed wheat, if immersed in water, so impregnated with saline particles, that an egg will float in it, and frequently stirred, so that all the unsound grains will rise to the top, which are then skimmed off, will be exempted from smut, provided, after the wheat is separated from the pickle, it is spread upon the floor, and a sufficient quantity of new slaked lime, to dry the whole, is sifted upon it *.

4. *It preserves the Seed when sown, from Vermin.*—In some parts of Scotland, where the oat crops were frequently destroyed by grubs, &c. it has long been a practice to mix salt with the seed, in the proportion of one to thirty-two, but sometimes one to sixteen. Every means has been taken to ascertain the utility of the practice, which has been found to be attended with uniform success. Salt destroys vermin in the ground, by making them void the contents of their bodies, the stimulus being too powerful for them to withstand. It has this additional advantage, that the vermin thus become food for those very plants, which otherwise they would have destroyed †.

5. *It promotes the Vegetation of Oily Seeds.*—This was first discovered in America, in the culture of flax, and it has since been ascertained in this country, by the experiments of Mr Lee, of Old Ford, near Bow, in Middlesex. The quantity of salt should be the same as that of the seed sown, namely, about three bushels per English acre. It is strewed on the surface after the seed has been sown. It improves greatly the quantity and quality of the flax, and in particular the quantity of the seed from the new crop. Though the experiments have hitherto been confined to flax, it would probably answer equally well with other seeds of an oily quality. It is supposed, indeed, that salt is most useful, when it is mixed with substances containing oil, the union of the two, being converted into a species of saponaceous matter, which is favourable to vegetation ‡.

6. *It increases the Produce of the Pasture Land and Meadows.*—It has been proved by experiment, in Cheshire, that after draining sour rushy land, if salt be spread upon the surface, in the month of October, its effects on the crop of next year, will be in the highest degree satisfactory. In one spot, where eight bushels were spread, a most flourishing crop of rich grass appeared in the month of May, but a

* East Lothian Report, p. 111.

† Lord Dundonald on the connection of Agriculture with Chemistry, p. 138.

‡ Equal quantities of salt, and of turnip seed, were tried on a small plot of a garden, by the author of this paper; and the produce was more abundant, than from the same quantity of turnip seed, sown without salt. The efficacy of salt, as a destroyer of the turnip fly, or beetle, ought to be ascertained.

still stronger crop in the month of July, where sixteen bushels had been applied *.

It is stated, on most respectable authority, that salt, sown thinly by the hand, will destroy the moss with which meadows, and pasture lands, are so apt to be infested †.

In the Netherlands, Dutch turf ashes, which are strongly impregnated with saline particles, are applied to the second, as well as to the first crop of clover, with great success; and Mr Hollinshead strongly recommends sowing six bushels per acre, on meadows, after the hay is got in, particularly in dry and hot summers, and upon limestone and sandy soils. The moisture which the salt attracts and retains, powerfully assists vegetation, and produces a crop greatly superior in quality to that obtained by the application of dung ‡.

For meadows, it is found to be an advantageous practice, to mix sixteen bushels of salt, with twenty loads of earth, per acre, turning the heap over two or three times, that the substances in it may be thoroughly incorporated, and spreading it on the surface, either in summer or spring §.

7. *It improves the Quality of Hay.*—The practice of salting hay, at the time of stacking it, has been practised in Derbyshire ||, and in the North Riding of Yorkshire ¶. The salt, particularly when applied to the second crop of clover, or when the crop has received much rain, checks the fermentation, and prevents moulding. If straw be mixed with hay, the heating of the stack is still further prevented, by the straw imbibing the moisture. Cattle will eat, not only such salted hay, but even the straw mixed with it, more eagerly, than better hay not salted, and will thrive better upon it.

Lord Somerville was of opinion, that salt could not be conveyed into an animal, in a more effectual manner, than by sprinkling it through a sieve, at the rate of twenty-five pounds weight of salt, to a ton of hay, when in the act of putting it together, for every particle is imbibed in the fermentation, without a possibility of waste. This salted hay is of great use to sheep, when put on turnips early in the season; for the tops being then rank and strong, many of the sheep die suddenly from pent-up wind, occasioned by excess of fermentation in the stomach. Salt, or salted hay, is then devoured by them with greediness, which denotes their salutary effect. By the use of salted hay, Lord Somerville did not lose one sheep on turnips in the autumn 1801, though the season was rainy and unfavourable **.

Dr Paris likewise contends strongly for improving bad hay by salt, applying it in the proportion of about one cwt. of foul fishery salt to three tons of hay. But of pure salt, a third of that quantity may be sufficient. It should be sprinkled between the layers. It prevents

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* Cheshire Report, p. 236.

† Sir Thomas Bernard's Treatise, p. 103. See Col. Scobell's Evidence, ditto, p. 270, note, as to its efficacy in removing moss on old leys.

‡ Hollingshead on Salt as a Manure, p. 26.

§ Hollingshead on Salt as a Manure, p. 25.

|| Derbyshire Report, vol. ii. p. 182.

¶ North Riding Report, p. 177.

** Sir Thomas Bernard's Tract on the Salt Duties, p. 262.

mildew, and renders the hay more grateful, and more beneficial to cattle *.

8. *It renders coarse food more nourishing, and moist food less injurious to Cattle and Horses.*—The ancients were accustomed to prepare their straw for feeding stock, by keeping it for a considerable time, *sprinkled with brine ;*—it was then dried, rolled up in bundles, and given to oxen instead of hay †.

Mr Curwen finds, that if salt be given to cows, with steamed chaff, and other inferior food, it makes them eat it up completely; and that, in a certain degree, it corrects the taste of milk when cows are fed on turnips, and increases the quantity they produce. In Cheshire, they give their cows a little salt when they are falling off in their milk ‡.

In Flanders, it has been found, that a small quantity of pounded salt, is very beneficial for horses, when new oats are given to them, if the oats are at all moist; and there can be no doubt, that moist food in general, might be rendered less injurious, by the same means; for instance, when raw potatoes are first given to horses.

Mr Curwen is convinced, by experience, that chaff and straw, might be rendered available to a much greater extent than at present, by the use of salt.

9. *It preserves Stock from Disease, and improves their Condition.* In several countries, as in America, the East Indies, Flanders, Sweden, and Spain, it has been found that salt given to domestic animals, is advantageous to them in various respects. It may be proper, however, to consider the best mode of applying it to the different sorts of stock, under distinct heads.

Horses.—Mr Birkbeck, in his notes on a journey in America, recently published, mentions, that the horses which he saw in the interior of that country, were of an excellent description, *and were in high condition, even when travelling at the rate of forty-five miles per day on long journeys.* They are fed well, getting from four to five gallons of oats per day, besides hay, *with a good handful of salt about twice a week.*

It appears from an experiment tried at Mr Alderman Farley's Salt-works at Droitwich, that salt is of great use to horses. The quantity given was about four ounces, three days in the week, alternately mixed with chaff. The whole four ounces, should not be given at once, but at several times in the day, about a table-spoonful each time. It makes the animals eat their food, and do their work better §.

Mr Curwen gives his horses employed at the farm, the colliery, &c. at the rate of four ounces per day, with their steamed potatoes, twice a day. It makes them clean out their cribs, and is a great benefit to their health and condition.

Salt given to horses, cures *the botts ;* and it is said, might be given with great advantage to race horses, and would prevent the necessity

* Sir Thomas Bernard's Tract on the Salt Duties, p. 262.

† Dickson's Husbandry of the Ancients, vol. ii. p. 409.

‡ Sir Thomas Bernard's Tract, p. 96. This makes them drink more abundantly, which increases the quantity of their milk.

§ Sir Thomas Bernard's Tract, p. 264.

of applying those severe purges, to which they are at present subjected.

Cattle.—The uses of salt to cattle are various. Besides increasing the quantity, and improving the quality of their milk, as already stated, it prevents their *hoving*, when fed on clover, or on turnips; the tops of which have the same effects as clover, both on cattle and sheep, when eaten in any quantity.

Mr Curwen's experiments on this head, are most important. From the 19th of November 1817, to the 3d of February 1818, he gave salt to his cattle in the following proportions:

Sort.	*Number.*	*Quantity per day, in ounces.*
Cows and breeding heifers, ...	40	4
Young and fat cattle, ...	43	3
Working oxen, ...	18	4
Heifers and young oxen, ...	21	2
Young calves, ...	20	1
	142	

The cattle are said to have been in the highest state of health, ever since the use of salt was commenced; no obstructions, or inflammations occurring as formerly, and not a single animal out of order.

In some parts of America, they give salt to their cows, at the rate of about two bushels per annum.

In the East Indies they give salt to their bullocks, in general daily, to the amount of two or three ounces, mixed with their feed of pulse. A due proportion of salt they consider to be essential for their health, and almost as necessary as food.

Sheep.—The advantages of salt to sheep, are very great. It improves their wool considerably, as is experienced, both in Spain, and in the Shetland Islands, where the pastures are so much impregnated with sea spray. It likewise prevents the rot, and destroys the different sorts of worms which are found in the bodies of sheep, in particular, liver worms, (*Fasciola hæpatica* *). It is said to protect them likewise from the scab.

In Spain, they give 128 lb. of salt to 1000 sheep in five months; but, in a wetter climate, like that of Great Britain, Lord Somerville thinks, that a ton of salt, for every 1000 sheep, would be requisite. It should be given them in the morning, to counteract the bad effects of the dew. In dry weather, a small handful may be put on a flat stone, or slate, and 10 or 15 of these slates or stones set a few yards apart, are enough for 100 sheep. If the sheep are brought to the place where the salt is put, they will lick it up quickly, if they find a craving for it; but if they do not want it, the salt may be taken up, and reserved for future use. This may be done twice a week, but in particular cases it may be offered thrice †.

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* Baron Scultz's Observations on Sheep. Communications to the Board of Agriculture, vol. i. p. 318.

† Sir Thomas Bernard's Tract, p. 261.

Mr Curwen finds, that salt prevents what is called the sickness in the northern parts of England, or the *braxy* in Scotland, by which so many thousand young sheep are annually lost; a discovery of the greatest importance in those parts of the kingdom.

Hogs.—Great quantities of salt are considered to be injurious to hogs; but in America, salt is occasionally given to them, to render them tame, and to prevent their being lost in the woods *. Mr Curwen also mixes some salt with the steamed potatoes which he gives to his hogs, and he thinks with benefit.

Poultry.—Salt also, may advantageously be given to poultry, and may prevent some of those disorders to which they are liable. The avidity with which pigeons consume salt, is well known.

On the general Uses of Salt to Stock.—This article is found serviceable, in restoring the tone of the stomach, when impaired by any excess, either of food, or of labour. It improves the quality of their dung, and renders the sprinkling of it with salt unnecessary. It renders stock tamer. Mr Curwen finds that the sheep gather round the shepherd, and will hardly suffer the salt to be deposited on the stones. It overcomes all their natural fear and timidity of disposition: and as to other cattle, it brings the wildest of them to feed out of the hand. In America, milch cows are so fond of salt, after being a little accustomed to it, that if tempted to wander in the woods, they are sure to return, in order to procure their usual allowance. But above all, it preserves the health of stock. Mr Mosselman, an intelligent farmer in the Netherlands, who keeps above 100 milch cows, oxen and calves, 23 working horses, and 250 sheep, has used salt for five years, *during which time his whole stock have been perfectly free from disorders.*

On the Modes of giving Salt to Stock.—Some give it in a powdered state on slates, stones, or coarse cloths. Others put large lumps of rock-salt, in the cribs or mangers of their stables and cow-houses, or hang it up so as to be accessible to cattle or sheep, who obtain, by licking, what they require. In Sweden, they imagine that the good effects of salt may be greatly promoted, by what are called licklings *(slekor)*. They consist of salt, pulverised wormwood, and juniper-berries, and are given, either in a coarse powder, or made with tar into a thick broth, or electuary, put into a hollow fir-trough, placed in the middle of the sheep-house, over which branches of fir are nailed across, to prevent the sheep from soiling themselves with the broth. Others mix brimstone with this pottage, and make balls of it, which may be particularly suitable for such sheep as are subject to eruptions. Some persons also mix with it tansy *(tanacetum vulgare)*, bay-berries, and garlick, as being good for the worms and the dropsy.

10. *It has a tendency to prevent Rust or Blight in Wheat.*—In the course of a most extensive inquiry into the causes of the rust, or blight in wheat, and the means of its prevention, it appeared, that Mr Sickler, a farmer in Cornwall, was accustomed to manure his turnip land with the refuse salt from the pilchard fishery; and that any

* Birkbeck's Notes on America, p. 138.

ground thus treated, *was never liable to the rust or blight,* though it infested all the neighbourhood *.

This important circumstance is confirmed in a recent communication (dated 15th May 1818) to the author, from the Reverend Robert Hoblyn, whose wheaten tillage, on a farm in Cornwall, was increased from 20 to 40 and 50 acres per annum. He used one ton of old salt, with one ton of fresh fish, mixed with earth, and from 20 to 30 ton of sea sand, and his crops, he states, were always good, "*and* "*never infested with rust.*"

It is probable that the salt, is the only article in this compost, that could be of material service in preventing the rust, by its checking putrefaction, the result of too frequent a repetition of corrupted manures. It is well known, that the rust does not attack plants in a state of perfect health. Its general cause is, the over-fulness, or over-luxuriance of the plant, from its being glutted with rank and unwholesome food. Hence the advantage of applying smothering crops, as tares, potatoes, hemp, &c. which prevent the growth of rust. Hence wheat planted in a rich compost of dung, attains such excessive luxuriance, as to become rusted, and incapable of bringing its seed to perfection †.

Conclusion.

There is every reason to hope, from this enumeration, that important benefits to agriculture will result from the reduction of the duties on salt. But the anxious endeavours of Parliament, to promote the interests of the farmer, will be in vain, unless he resolves to avail himself of the boon that has been thus conferred upon him. For that purpose, his attention to the various particulars above stated, is most earnestly requested.

No. IX.

ACCOUNT OF MR HUNTER OF TYNEFIELD'S SYSTEM OF FARMING.

The system of farming adopted in the more improved districts of Scotland, being much celebrated, it may be proper to give the following account of the plan pursued by Mr Hunter of Tynefield, near Dunbar, who is justly accounted one of the most intelligent farmers in East Lothian. It goes upon the principle, of converting nearly all the straw of a farm into dung.

Mr Hunter's farm consists of 350 Scotch, or 437 English acres. The horses kept for labour are sixteen, or about one horse to 27

* Husbandry of Scotland, vol. ii. App. p. 150, note.

† Hayward, p. 160.

acres. The other stock varies according to the quantity of green food produced in the course of the season. It is only necessary to observe, that about ten sheep, weighing from twelve to fourteen pounds per quarter, require from thirty to thirty-two tons of turnips (rather more than the average produce of an English acre), to fatten them for market *. Mr Hunter also keeps some cattle for winter *soiling* †, (if that expression can be made use of), which are bought in October and November, and sold in March. The sheep are fattened sometimes sooner, but the above weight of turnip will keep them till that time. The cattle are sold as soon as fattened, if the market offers, and are sooner or later ready, in proportion to the condition they may be in when put up to feed ‡.

Mr Hunter raises from four to five acres of turnips, for one of ruta baga: the latter, however, requires one-third more manure, to produce a full crop.

The crops Mr Hunter raises of turnips, and of ruta baga, are as follows:

1. *Turnips.*

	Tons per Scotch Acre.	*Tons per English Acre.*
Greatest crops, turnips 38 tons, tops 6 tons,	44	35
Smallest crops, - - -	32	25
Average about	38	30

2. *Ruta Baga.*

	Tons per Scotch Acre.	*Tons per English Acre.*
Greatest crops, - - -	32	26
Smallest crops, - - -	23	14
Average about	27½	20

Mr Hunter was accustomed to make the intervals of the rows, from twenty-seven to thirty inches. He found, at that time, the crops to average about three or four tons less per acre than he now

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* At this rate, an acre of turnips fattens from 459 to 500 lbs. of mutton, and nearly as much of beef, which is in the ratio of from 16 to 17 lb. of meat, for every ton of turnips.

† Soiling is commonly understood to mean, giving *succulent herbage* to live stock; but if it properly means *making dung*, it may also be applied to the giving *of roots*, for the purpose of feeding animals, *and providing manure.*

‡ It is calculated, that an acre of good turnips, would feed two and a half cattle of 30 stone Amsterdam each, 17½ oz. to the pound and 16 lbs. to the stone; but say, that only two cattle are fed on the produce of an acre of turnips; in that case, it is contended, that 440 lbs. Amsterdam weight, or more of beef than mutton, would be produced, from equal weights of turnips, provided that the turnips be consumed *at the stall by the cattle.*

does, when he makes the intervals from twenty-four to twenty-six inches *.

Mr Hunter begins to sow winter wheat after turnips, whenever the weather will permit in January, and continues sowing, when the weather is dry, till about the twelfth of March. He afterwards sows the whole of his turnip break or shift, with summer wheat, of that sort recommended by Sir Joseph Banks. He had it from Lincolnshire several years ago, and has sown it at all times, during the spring months ; but he has now ascertained, that the proper time of sowing it, in the climate of his neighbourhood, is the two last weeks of April.

The weight of hay, from clover and rye-grass, may average 150 stones of twenty-two pounds each, per English acre. But this is the weight in spring. If weighed *from the field*, it would weigh a good deal more, though produced on a soil, not much calculated for a crop of hay, namely, a light soil, incumbent on gravel. Where the soil is of a better quality, 200 stones have been produced.

Mr Hunter sows wheat after clover, about the middle of January, if the season will allow, if not, as soon after as possible. He ploughs his clover stubble early in December, so that the snails, or other vermin, bred among the clover, may be turned up and destroyed. Formerly, he used to plough and sow in November, but these vermin, not being then in a torpid state, crept into the ground again, and coming out in spring, thinned the wheat materially. Ploughing in December, and sowing in January or February, have answered his purpose of destroying them effectually.

The produce of wheat after clover, is eight bolls per Scotch acre, or twenty-seven bushels per English acre; that of oats is ten and a half bolls per Scotch acre, or fifty-two bushels per English acre.

Mr Hunter pastures very little with cattle or horses; indeed he proposes giving it up altogether, unless in barren soils, where the plough cannot be introduced; and he means to convert any clover that may be left from soiling, into hay, for his horses in winter and spring. By giving fourteen pound of oats per day to a horse, with ruta baga, he has been able to save a third part of the allowance of oats given to his horses, when no hay or ruta baga were used. On the above allowance, Mr Hunter's horses are worked nine hours every day, when the weather will permit.

The manure hitherto given to turnips by Mr Hunter, has not been so great as he wished ; but as the quantity on the farm increases, a greater proportion has been applied. Mr Hunter is quite satisfied, that the land can never be over-manured for turnips.

The depth of the first furrow, for the turnip fallow, is from nine to twelve inches, where there is a depth of soil; the after-ploughing about six or eight; after the turnips have been eaten off, the ploughing ought to be about three inches for wheat, to prevent the seeds of

* This can only be attempted, however, where the land is in very good condition. Intervals of from twenty-eight to thirty inches are to be preferred, with land not in good condition, or where abundance of manure cannot be given.

annual weeds being brought up; after the clover, four or five inches are a proper depth for oats or wheat.

The stock kept upon turnips or clover, have the free use of water at all times when soiling; *cattle in summer must have it.*

When turnips are taken up to the extent of a half, four rows are left, and four taken up alternately; if a third part is to be taken, six are left, and three taken alternately. As soon as the turnips or ruta baga begin to run or shoot in spring, they are taken off the field, when the tops and roots are cut off; they are then piled up in some place, sheltered from the sun or too much air; and being covered with a little straw, and kept moist, they may be preserved as long as they can be wanted; the ruta baga will be perfectly good to the first of June.

Mr Hunter sows no more barley, than is required for paying his farm-servants their wages in kind, which are partly paid in barley; having from experience found, that wheat after clover, sown with barley, often fails on his soil, which he was not aware of, when he first began farming *.

When circumstances permit, Mr Hunter limes once in fourteen years, at the rate of 60 barley bolls per English acre. Lime ought to be applied to all lands, under a rotation of four crops, where white and green crops are sown alternately.

The weight of potatoes per English acre, under good culture, and a proper soil, is from eight to ten tons. Mr Hunter was accustomed, before he found that horses throve on ruta baga, to give them potatoes occasionally, though they did not thrive so well on them, even when steamed, as he could have wished. He has now laid potatoes entirely aside, unless those raised for swine, finding ruta baga greatly superior for horses.

It is proper to explain the system adopted by Mr Hunter, for cultivating light land. The basis of that system is, 1. Alternate white and green crops; 2. Converting nearly the whole of the straw produced on his farm into dung; 3. Ploughing deep at particular periods; and, 4. Soiling both summer and winter.

1. The rotation which he follows is, 1. Turnips; 2. Wheat; 3. Clover; 4. Wheat or oats; half of the clover being pastured with sheep, whilst the other half is used in soiling work-horses. The clover stubble is broken up for wheat or oats, generally in the proportion of two-thirds for wheat. Under the above rotation, the crops on an average, have increased in produce considerably.

2. Mr Hunter's object is, *invariably to convert almost the whole of his straw into manure;* for by giving plenty of green food, very little of the straw is eaten by cattle or sheep, either in summer or winter. Horses, indeed, require at all times some straw, along with ruta baga; more especially in November, and the first months of winter, when ruta baga has not reached its full growth, a few of these

* It is an old Scotch maxim, "He that saws wheat after bear, had need of "meikle gear;" or, he should be a rich man, who sows wheat after barley. But it is probable, that on rich land, this rule need not be enforced.

roots are given, and a greater proportion of straw or hay is wanted. If any considerable quantity of clover can be converted into hay, the straw will be perfectly unnecessary, unless for litter.

3. Soon after Mr Hunter began this system, he thought that the turnip, and other crops, were rather falling off, but fortunately he discovered a remedy, which was to plough very deep the first furrow given to the turnip fallow. This he did, whatever was the depth of the soil, sometimes using three or four horses in the plough. Since he adopted that practice, all the crops are more certain, seldom if ever failing, unless owing to the inclemency of the season, and never from being often repeated.

4. Mr Hunter makes it a rule, to soil both summer and winter, preserving as much straw from the winter soiling-fold, as will be sufficient for littering horses, young cattle, and swine during the summer; giving always plenty of green food, chiefly clover. Soiling in an open fold, with cut clover, in summer, does not require so much straw, as winter soiling with turnip. He has not ascertained the proportions exactly, but thinks, that one-half of what is required in winter, will be sufficient in summer.

The stock are fed in the following manner: They have always abundance of green food or roots. One-half, or sometimes one-third of all the turnips produced upon the farm, are carted to the fold or straw-yard, to sheep, young cattle, and swine. The swine have at all times clover in summer, and turnips or ruta baga in winter, together with potatoes, for those meant to be fattened. The working horses have also half a bushel each of ruta baga during winter and spring, so that all the stock are soiled, the milch cows excepted, which get the whole chaff, and other refuse from the thrashing-mill, and the sheep, when they are pastured on clover, to consolidate the ground. Within these few last years, instead of feeding his pigs with raw or boiled potatoes, Mr Hunter gives them one-half Swedish turnip. He has a boiler filled with the turnips, sliced, to which a board is fitted, to prevent the steam from going off; a tin pipe is let into it of sufficient length to reach the steamer, into which the potatoes are put; by which means, both potatoes and turnips are done at once. They are both then put into a tub, and mixed together with the water in which the turnips were boiled, forming a mess, which far exceeds giving either by itself. The animals eat it greedily, and thrive apace. The water in which the Swedish turnips are boiled is found to be extremely nourishing.

Mr Hunter is decidedly of opinion, that any soil adapted for turnips, and which will produce seven bolls of wheat per Scotch acre, *(or say 24 bushels per English acre)*, or nine bolls of oats per Scotch, *(or 44 bushels per English acre)*, cannot be put under a more profitable system, or rendered more productive, than in the way he has adopted. By the frequent ploughings given to the turnip break or shift, the land is made perfectly clean. Turnip is the only crop, for which, according to Mr Hunter's experience, land cannot be overploughed. So much ploughing for turnip, would, in his opinion, be hurtful to the after crops, were it not, that one-half or more of his turnips, are eaten on the ground with sheep, which brings it to a proper consistence for the succeeding crops of wheat, &c. Where land has been over-cropped, or it may be rather said, *over-ploughed*, farmers will find two or three years' pasture necessary, to consolidate the soil; but he is so partial to soiling, that he thinks two years' soiling, preferable to two years' pasturing, even though the second year's crop should be greatly deficient; as he is certain, from his whole practice, of constantly having oats after cut clover, as well as the other crops, fully equal to those after pasture, and is assured that the produce will be equally great, during the whole after-crops in the rotation.

This idea of soiling two years in succession, instead of pasturing the second year, is justified by the opinion, that one acre soiled, is equal to two pastured *.

No. X.

OBSERVATIONS BY FRANCIS BLAIKIE, ESQ. ON THE ERECTION OF FARM-HOUSES AND OFFICES.

Much has been said, and volumes have been written upon the designs and situations of farm-buildings; but the construction of those buildings, and the execution of the work, are seldom properly attended to. A few leading principles, and prominent errors, shall be here pointed out.

Situation.—In fixing upon the situation, *water* ought to be a primary consideration. If a well is to be sunk, that ought to be done in the first instance, and the quality and supply of water proved. There have been many instances of water being carried from great distances, and at much expense, to mix mortar for erecting buildings, and immediately after their being completed, the wells have been sunk.

Foundations.—The earth should always be thrown out a proper width and depth to give a good foundation, and where the ground is not sound, it should be well piled before the foundations are laid. When the subsoil is retentive of wet, or where it is springy, drains should be carefully laid in the foundations, so contrived as to lead the water from the buildings, and discharge it at a lower level. Iron grates should be built in those drains near their ends, to prevent rats and other vermin entering them. When grates are set up at the ends they are frequently stolen, or otherwise removed. No building can possibly be wholesome for man or beast to lodge in, when water stands stagnant in the foundations, or even when dampness prevails,

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* This valuable paper, was highly approved of, by that most intelligent agriculturist, John Middleton, Esq. who remarked, that few whole volumes contain so much important information. For the south of England, Mr Middleton recommended winter tares before turnips.

This paper would be an excellent model, for other intelligent farmers to draw up accounts of their respective plans of operations.

though this water does not absolutely appear. Disease is frequently engendered from those causes, and great care ought to be taken in laying the foundations of buildings upon a dry bed.

Ground level or floor line.—The line of the thresholds is frequently fixed too low. The surface level of the ground is usually taken as the floor line of the buildings, and that without consideration, or if thought of at all, the pitiful saving in the expense of foundation, is put in competition with uncomfortable and unwholesome lodgings for man and beast, mouldy provender, and rotten wood-work. It is more proper to step up, than to step down, from the yards into the buildings.

Ground Floors.—The ground floors of buildings should be made thoroughly dry, whether they are paved, boarded, or laid with clay. The natural soil should be removed, and the space filled up with other substances. Thus, if the natural soil is even dry sand, it is necessary to remove it at least a foot deep, and replace it with clay. Where soil and subsoil remain in buildings *unbroken*, they absorb wet like a sponge, and damp floors are the natural consequence.

Walls.—When walls of farm-buildings are composed of chalk or stone, it is necessary *to see* that they are worked solid, not only with a view to insure their stability, but to prevent harbours for rats and mice. The cross walls should if possible be carried up at the same time with the outer walls, so as to strengthen the building. Barn walls are apt to fracture at the corners: abutments of solid masonry placed on good foundations should therefore be carried up inside of the angles at the same time with the walls, and worked into them. That precaution effectually prevents angle fractures in barn walls, and is alike applicable to many other farm-buildings. Air holes in barn walls are of no real use, and in some respects lead to much injury. They weaken the buildings, they admit damp to the corn in the bags in hazy weather, and they are thoroughfares for vermin. Those air holes are intended to dry corn when housed in a damp state. But damp corn invariably becomes mouldy between brick or stone walls, and is not at all improved by the air holes.

Roofs.—The roofs of farm-buildings are seldom well constructed. They are generally composed of home grown timber felled indiscriminately at all seasons of the year, improperly treated after it is felled, and cut up and converted without due consideration. The most prevalent errors in construction are, the scantlings of the timber cut too small; the cross or tye beam too weak, and not firmly attached to the wall plates; the pitch of the roofs too flat; the rafters too long and too weak, unsupported by purlins; the purlins too weak, and too long bearings, and not well braced or strulted up; and the principals weakened by the purlins being mortised into them.

Doors and Windows.—Outer doors and window frames should be made of the most durable timber, such as oak, sweet chestnut, and locust acacia. Home-grown fir may be used for inner-doors and door-jambs, and all inside work, but the boarding of outer-doors and windows should be of Baltic red wood deals.

Covering.—Farm-buildings are frequently covered with tiles. Flat tiles are a heavy covering, requiring strong timbers in the roof to support them, and they are seldom of a durable quality. Pantiles are lighter covering, more durable, and altogether better that flat tiles. Particular care and attention should be paid to laying, or, as it is locally called, "*hanging*" pantiles. Those tiles are usually either bedded upon mortar, laid on lath or beel, or they are hung on loose, and sometimes painted afterwards in the inside. In the first case, the roof becomes a harbour for rats, mice and sparrows ; and in the second, they are liable to admit wet, and to be blown off by high winds. In laying pantiles, on the best principle, one man works on the outside, and another in the inside of the roof. The outside man keeps a choice of tiles handy to him upon the roof; having fitted a tile, he mortars the top of the tile previously laid in the row; he fills the roll of the tile in his hand with mortar, and presses it down in the place to which it had been fitted; he then draws his trowel under the edges of the tile to smooth the mortar. The inside man uses his trowel at the same time; he has a board of mortar at hand, and points the joints of the tiles close up, pressing the mortar against the man's trowel on the outside; and this whole mass, tiles and mortar, then becomes closely cemented together, forming a complete barrier to wind, wet, snow and vermin. Bricklayers are always desirous of doing the outside work in the first instance, and reserving the inside for bad weather. They never should be allowed to do so, because fresh mortar will not adhere to dry on the roof of a house. Pantiles should be well seasoned in water when laid on roofs in dry weather. Foreign fir, home-grown larch, willow, and poplar, make good pantile lath.

Seasoning Timber.—Oaks, and other tanning barked trees, peeled in spring, should be immediately put into water, and remain there, at least six weeks, for the purpose of extracting the sap, and preventing the timber from rending or splitting. When timbers are large, and unwieldy, they may be cut into scantlings before they are put into water. Ash, elm, beech and other deciduous trees, not having tanning barks, should, if possible, be felled before Christmas, and never after January. Those timbers should also be watered after they are cut into scantlings, in the same manner as oak. The rot worm is not liable to attack watered timber. When larch bark is stripped for tanning the trees should be watered the same as oak, and for the same reasons. Larch bark is about half the value of oak bark for tanning purposes. Home-grown evergreen fir trees, intended for building purposes, may be felled at any time of the year, provided they are removed quickly to the saw pit, cut into the required scantlings, and set up in the drying peaks. If those trees lay only a short time on the ground, either before, or after being sawn, they contract mildew. The silver fir is the most valuable for building purposes, and grows well upon chalky subsoil, where other varieties of the fir tribe generally fail. Carpenters do not approve of silver fir, because it is hard to work. These objections should be a recommendation to the proprietor.

No. XI.

HINTS ON THE DIFFERENT KINDS OF CATTLE FARMS, AND ON THE DAIRY HUSBANDRY.

CATTLE farms may be classed under various heads;—as, 1. Breeding;—2. Grazing;—3. and Suckling farms;—and, 4. Farms where the dairy husbandry is carried on.

A few concise observations under each of these heads, are all that the limited extent of this work will admit of.

1. *Breeding Farms.*

In breeding cattle it is proper, (if the size of the farm will admit of the rule being observed), to separate the different ages, and to graze them, as much as possible, in distinct pastures, as the older have a jealousy of the younger, driving them from the best grass, and sometimes doing them material injury.

Bulls will retain their vigour till they are twelve or fourteen years old, and there are instances of their being kept till they are even nineteen years; but they are certainly in their prime from three to six. They ought always to be pastured in the same field, which prevents their acquiring an inclination to ramble, and the cows should be brought to them. By some farmers it is considered to be an advantageous plan, to work the bulls with the oxen, as they are thus rendered tamer, the owner has the profit of their labour, and all risk of their doing mischief is prevented.

Mr Bakewell used to put off sending his heifers to the bull till three years old, but his cows often missed calf, which might be owing to that circumstance. It is better, therefore, to send them to the bull, at two years old, and some strongly recommend even an earlier period. The Dutch cows generally have a calf at two years' old, which doubles the stock in two years. The cows would grow to a much greater size, if they had no calf till the third year; but as, in that case, the stock would not be doubled till three years, the present custom is reckoned more profitable *. In the northern counties they wish their cows to calve when the grass is abundant. This, it is supposed, opens their milk vessels, and is a great means of rendering them ever afterwards good milchers; which is not the case, unless nature is early made to have a tendency to that species of secretion. It has been found a good plan, to give the whole of the milk, *a young cow yields*, to the calf, when it is permitted to suckle the mother. This she readily gives, and thus gets into a good habit of milking.

Bull calves † are sometimes nursed by hand, but generally by the

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* The Harleyan Dairy System, p. 166.

† It has been remarked, that if a cow goes beyond her time, a male calf is generally produced.

mother. It is said that Mr Bakewell had two nurses for some of his favourite stock. On the other hand, in the north of England, where rearing a number of cattle is the object, they sometimes put two calves to one cow. Hay tea * is sometimes given them, and in spring, eggs when they are cheap; but linseed is the best substitute for milk. The calves are served with linseed twice a day, at the rate of an English pint of linseed, and twelve quarts of milk, for twelve calves, which, with thirty-six quarts of water, is boiled into a jelly; a gallon of this soup is given to each calf twice a day. The linseed should be crushed.

2. *Grazing Farms.*

Grazing occupations are chiefly employed in fattening stock for the market.

Some graziers have adopted the following mode of feeding stock: Suppose there are four inclosures, of from six to ten acres each, one of them is kept quite free from stock, till the grass has got up; and then the prime or fatting cattle is put into it, that they may get the best of the produce; the second best should then follow, and the young store after all, making the whole feed over the four inclosures in succession, as follows:

1. Inclosure.	Free from stock, till ready for the best cattle.
2. Ditto.	For the best cattle, till sent to No. 1.
3. Ditto.	For the second best, till sent to No. 2.
4. Ditto.	For the young cattle, till sent to No. 3.

Thus, one inclosure is kept free from stock, till the grass gets up, and it is ready for the prime cattle.

The proper size of inclosures, has never yet been ascertained by experiment. From ten to thirty acres are in general to be recommended. But the size should be various, as small inclosures are best in winter, and large ones in summer; and small ones are better calculated for grass, and large ones for corn. Mr Bakewell was a friend to small inclosures. Probably the best plan to adopt is, to feed cattle entirely in the house, or *soiling* them, as it is technically called. In that case, small inclosures would be preferred, as the shelter which they afford, is extremely favourable to the growth of herbage.

The larger a bullock is, he must take the more food to support

* The following receipt for making hay tea, has been tried with success in the north of England. Take a large handful, or about 1 lb. of red clover hay, well got in, and 6 English quarts of clear spring water; boil the hay in the water until it is reduced to 4 quarts; then take out the hay, and mix 1 lb. of barley, oat, or bean meal, among a little water; put it into the pot or cauldron whilst it is boiling; keep the whole constantly stirring, until it is boiled and thickened. Let it cool to be lukewarm; then give it to the calf, adding as much whey as will make a sufficient meal. This is a cheap mode of rearing calves, and may answer the purpose as well as more costly ingredients. In this way, the valuable article of milk may be saved for other purposes.

him. It is desirable to change his food often, and to give him frequently, but little at a time, which makes him more eager to eat. After his kidneys are covered with fat, he will take less meat every week. It is better therefore, to ascertain the quantity he eats, by the week, than by the day.

Fatting cattle, to be sold immediately from the farmer's house, and not sent to market, should be kept moderately warm. If kept too hot, it makes them perspire, and causes their skins to itch. This vexes them, and they rub themselves against any wall or post within their reach, which is much against quick feeding. Currying and combing them are useful practices; and washing them, at least once a-week, is of great service. Bleeding is now exploded, as an unnecessary practice.

3. *Suckling Farms.*

The feeding of calves for veal, has long been practised in every part of the kingdom, and, when properly conducted, is a branch of industry of considerable importance, and from which an adequate profit may be derived. In Essex, the attention of the farmer, is chiefly dedicated, to the object of supplying the metropolis, with so important an article as veal, and the plan, in that district, is reckoned more profitable than grazing, or even the dairy. The mode of supplying the London market, as described by Dr Dickson, from the various authorities he quotes is, that the calves are bought at from twenty to thirty shillings, and kept till they fetch from L.4 to L.5, or sometimes from L.7 to L.8. He says, the business of suckling is reckoned to turn to good account, when each calf, in the progress of its fattening, brings a profit to the farmer of 3s. per week. In the report for the county of Middlesex, it is stated, that suckling of calves is more profitable than grazing or fattening; but not so profitable as the dairy; And the surveyor of the county of Essex reports, that the suckling of calves for twelve weeks, will pay at the rate of 4s. 6d. each calf, per week.

But by far the best conducted system of feeding veal, to be met with in the island, is in Lanarkshire, and more especially in Strathaven and its neighbourhood, for there it yields a profit, that has never been equalled in any other part of Britain. Some calves, after being fed, from five to six weeks, on the milk of their dam, will bring from L.3 to L.4, 10s. each, according as the animal may have been of a thriving sort or otherwise, and as veal may happen to be in demand at the time; and as a new dropped calf, can be procured at from 6s. to 10s. or 12s., and brought to those prices in five or six weeks, upon the milk of one cow, the return is more than quadruple that mentioned in Essex, notwithstanding its vicinity to London. Many calves however, are fed in that district, to a much greater pitch than can be accomplished with the milk of one cow, which cannot carry on a calf to advantage, longer than about five or six weeks. After that age, the calves get the milk of two cows, and in some instances of three cows, divested of the first drawn, which is poor in quality. After being fed for several weeks in this manner, a calf will reach nearly the weight of a cow, and attain to a degree of fatness hardly to be credited. Mr Aiton, in his valuable treatise on the dairy, page 90, mentions many instances of calves being sold for veal, as high as L.10 and upwards, when the veal did not sell for more than 5d. or 6d. per pound, of 16 oz. A farmer in that district, (Mr Strang of Shawton,) fed, some years ago, a calf to the weight of thirty-five stones avoirdupois, and sixteen pounds to the stone living gross weight; and he was offered 14s. per stone of 16 lb., and $22\frac{1}{2}$ oz. per pound, which with the hide would have brought L.15 or more. Mr Granger in Dykehead, fed a calf to the weight of 22 stones 9 lb. county weight, of $22\frac{1}{2}$ oz. per lb. and 16 lb. to the stone. This calf brought, at 10d. per lb. upwards of L.15, besides the hide; and at the price veal has sometimes given in the Glasgow market, it would have brought L.25. It is certain however, that feeding to such a pitch, is not so profitable, as it is to sell the calves when about five weeks old, and to apply the milk to feeding another calf.

The method of feeding calves in Lanarkshire is simple and easy. During the first ten or twelve days after their birth, they do not get the whole milk of a cow, and if they are kept longer than five or six weeks, they require more than the milk of one cow. They are not allowed to suckle, but the milk is drawn from the cow, and given to the calf from a dish, and an artificial teat is put into the mouth of the latter, to make it draw in the milk slowly, and promote the secretion of saliva. The calves are fed twice every twenty-four hours, and are kept in a dark place, to make them quiet. They have abundance of dry straw for litter. In this district, they are neither bled, nor are any drugs given them. If they become costive, they get a little mutton broth, and a small quantity of rennet when too lax. They get no other food but milk.

The following plan, for carrying on the suckling process, has been adopted in other places.

As soon as the calf is dropped, it is put into a box made of coarse boards, $4\frac{1}{2}$ or 5 feet long, and 4 or $4\frac{1}{2}$ feet high, and about 2 feet wide, according to the size of the calf. The boards are not put so close, but that a sufficient quantity of air is admitted. Light however, is carefully excluded, and the box has a cover for that purpose *. The box stands on four feet, which at one end are four inches high, but at the other only two inches, and as there are holes at the bottom, all wetness is drained off. The bottom is also covered with straw or hay, which is changed twice a-week. For seven or eight days, milk is but cautiously given, for unless a calf is fed moderately at first, it is apt to take a loathing to its food. It should be bled in about ten days, and afterwards as much milk given it, fresh from the cow, either twice or thrice a-day, as it will take. The bleeding should be repeated once a-week; and at all times, when a calf loathes its milk, and does not feed well, bleeding ought to be repeated. These fre-

* All animals, when fattening, ought to be excluded from light as much as possible, as the best and safest mode of keeping them quiet; and infinitely preferable to soporific drugs, which are frequently given them. Exclusion from light is practised by those who fatten poultry for the London market, with much success.

quent bleedings are said to improve the appearance and quality of the flesh, and to prevent diseases from plethora, to which calves are subject, even when not fed so high, and still more so, when they are. A large piece of chalk should be hung up in the box, which the calf will lick occasionally. This contributes nothing to the whiteness of the veal, but it amuses the animal, promotes the secretion of saliva, and corrects that acidity in the stomach which might otherwise be engendered, and which often takes place. A cow calf is reckoned the best for veal. If a bull calf is suckled, he ought to be cut when about a week old. This, it is said, retards its growth, but it renders the veal whiter and better. On the whole, by this mode of treatment, calves are kept clean, quiet, warm and dry, the veal they furnish is excellent, and they are soon ready for the market *. This plan is certainly preferable to the practice of stupifying them with spirits, or with laudanum, so common in other places, where a different system is pursued.

4. *Dairy Farms.*

On the importance of the Dairy Husbandry.—The management of the dairy, is certainly a most important branch of rural industry, for when land is in pasture, or appropriated for the feeding of cows, a greater revenue can be drawn from it, than from any other mode by which the pasture can be consumed.

It has been stated on high authority, and on sure data, that the quantity of herbage that will add 112 lbs. to the weight of an ox, will enable a dairy cow to yield 450 gallons, or nearly 900 Scots pints of milk. That quantity of milk will yield from twenty-two to twenty-four stones, or about 385 lbs. imperial of full milk cheese ; or if made into butter, it will yield 170 lbs., and the butter-milk will bring a penny per pint. This is at the rate of nearly three and a-half pounds of cheese, or one and a-half pound butter, besides the value of the sour-milk, for each pound of beef, raised from an equal quantity of herbage.

Another proof of the superior advantages of dairy produce arises, from the much greater advance in its price, in comparison with that of grain, or the other ordinary produce of land, and which will probably continue in nearly the same proportion.

The average advance on the price of grain, since 1770, does not exceed 50 per cent., while cheese has increased from 200 to sometimes more than 300 per cent., and butter from 300 to more than 500 per cent., above what it gave 65 years ago. Even butcher meat has not advanced nearly in the same ratio as dairy produce.

2. *On the Climate, Soil and Circumstances, best calculated for a Dairy Stock.*—When the climate is damp, and the soil of so adhesive a nature, that the growth of natural herbage is somewhat luxuriant, though it be not of the very best quality, yet it is favourable to this branch of husbandry ; for it is well known, that a dairy cow pro-

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* Statistical Account of Scotland, vol. viii. p. 199, vol. ix. p. 384, and, in particular, vol. xix. p. 495, where an account of this mode is given, by a respectable country gentleman, the late Mr Paterson of Castle Huntly.

duces more milk with a full bite, though coarse, than with a scanty supply of finer herbage. The western side of both England and Scotland therefore, where the rains are more copious, and at any rate more protracted, and of course the herbage more luxuriant, is better suited to dairy husbandry, than the eastern side of the island, where the rains are less frequent, and the growth of the natural grasses more stunted.

The dairy however, may be carried on with advantage, in every part of Great Britain, where artificial herbage, or roots calculated for the purpose of producing milk, are raised for that special purpose.

3. *On the Breeds best calculated for the Dairy Husbandry.*—Dairy cows are not an indigenous breed, but are artificially formed, by human skill and industry; for such is the pliancy of the animal economy, that cows and various other animals, may be formed into something surprisingly different from the original stock. Much certainly depends upon soil and climate, and various accidental circumstances; but by the skill and industry of man, when properly applied, still greater changes can be effected.

The principal dairy districts in Britain are, those of Cheshire and Ayrshire. In regard to Cheshire, it is stated by Mr Holland, the intelligent surveyor of that county, that the average quantity of milk given by the cows there, may be calculated at eight quarts per day, for twenty-two weeks in the year, and the average return in cheese, at 300 lbs. each cow *.

Mr Aiton, who surveyed the county of Ayr, and has written an able work on the dairy husbandry, calculates, that each dairy cow of that breed, when properly fed and attended to, will yield, at the rate of 2000 Scotch pints, equal to 1000 English gallons, per annum. If the calf is produced about the beginning of May, the amount in milk will regularly diminish according to the following table:

The first 50 days	12	pints per day,		- - - -	600
Second 50 days	10	do.	do.	- - - -	500
Third 50 days	7	do.	do.	- - - -	350
Fourth 50 days	4	do.	do.	- - - -	200
Fifth 50 days	4	do.	do.	- - - -	200
Sixth 50 days	3	do.	do.	- - - -	150
					2000

And as every $7\frac{1}{2}$ or 8 pints of milk, give a pound of butter, of 24 oz. or $1\frac{1}{2}$ lb. imperial, the return of each cow, in the course of the year, will be from 375 to 400 lb. imperial of butter, for each cow every year. The butter-milk also, sells at a penny per pint, or L.8, 6s. 8d. from each cow in the course of a year; and as every 55, or from that to 60 pints of milk, gives a stone of 16 lbs. and 24 oz. to the pound of cheese, the return of cheese from each cow, in the season, is from 33 to 36 stones of that weight, or from 782 lb. to 864 lb. imperial, of full milk cheese, from each good milch cow, on an average.

Another excellence of the Ayrshire breed of cows is, that after

* Holland's Survey of Cheshire, p. 250.

they have given milk for several years, they fatten as well as ever, and that their beef is fully equal to that of any other breed. These cows also, do not take on their fat on the outside of the lean, or in any one place merely, but their fat is mixed, in thin strata, within the lean, giving their flesh the appearance of marble; and they always turn out better in the hands of the butcher, than a stranger to that breed would expect.

From these statements it is evident, that the dairy is a most important source of profit, and ought to be extended to many districts in the kingdom, where it is at present but little known *. In the neighbourhood of a town, the sale of the milk is probably the great object in keeping cows; but in the more remote parts of the country, if calves are not reared or fattened, cheese and butter, being so easily preserved and transported, are the proper articles to attend to, with the view, either to domestic consumption, or to foreign export.

4. *Rules for the Management of Milch Cows.*—The proper hours of milking, and how often per day cows ought to be milked, are points of considerable importance. In general, cows are milked twice a-day, at six o'clock in the morning, and at six at night. In this way a cow has twelve hours each time to graze or feed, and to prepare the milk for the pail †. When they are milked thrice a-day, if grazed, it occasions much unnecessary trouble to the dairy maids, not only in going to the cows, but also in preparing their vessels, (unless they have an extraordinary number of them), for holding the milk. It also puts cows from grazing, and diminishes their time for rest. Many, however, think it necessary, to milk their cows thrice a-day, when the produce of milk is great. The dairy-maid should take special care to treat the cows with as much kindness as possible, to prevent their taking any dislike to her, which would hinder their milking well; and should milk them *completely*, by which cows are prevented from becoming so soon dry as otherwise may be apprehended.

Cows are at their prime state for milk, the third or fourth summer they are in milk, and they will remain in that state till they are twelve years old and even more; but as the older they grow the worse they will fatten, some farmers begin to feed them when they are from eight to ten, even though they are good milchers. The propriety of this system may, however, be questioned. Whilst the value of the udder in a

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* I regret much to hear, that in many parts of England, the advantages of the dairy are not so well known as they ought to be; and that the lower orders of the people, cannot get a little milk or butter-milk for their children. I wish much to call the attention of the liberal and public-spirited country gentlemen, to a circumstance so important to so numerous a class of the community. The best remedies are, to have small dairy farms in the neighbourhood of all villages, bound to furnish the inhabitants with milk at a moderate price; and if the Irish mode were adopted by the English farmers, of churning *all the milk*, instead of the cream alone, such a supply of excellent butter-milk would be procured, as would be of infinite service to their neighbourhood.

Good dairy-maids are so extremely scarce in many parts of the kingdom, that it would be proper to encourage them by premiums, which are too often applied to purposes much less essential.

† In Holland and Flanders, the cows are milked twice a-day, at the early hour of three in the morning, and at three in the evening.

good dairy cow, exceeds the value of the cow, her pasture, and the necessary attendance, she may be kept to any age. The teeth, not the stomach, fail. Hence, as long as a cow milks well, she ought to be kept, as she can always be fattened by soft meat.

It has been remarked, that some cows will give a large quantity of milk, yet will yield little butter; and that a mixture of it will even prevent the cream of the other cows from churning. This is owing, either to the animal being in an unhealthy state, or to a predilection for particular kinds of herbage, not favourable to the production of good milk.

5. *Manufacture of Butter.*—Making of butter seems to have been understood, from the earliest periods of society; but like every other operation on milk, great improvements have been made on its manufacture in modern times; chiefly with regard to cleanliness, and the due regulation of temperature. When butter is made from cream only, and the skimmed milk made into cheese or other food, the milk is kept in coolers, from four to six inches deep, and from twenty-four to thirty-six hours, till the cream rise to the surface. Where the dairies are small, and the cream has to be collected till as much is got as may be convenient to be churned together, it is proper to stir the cream in the vat, twice every day, with a wooden spurtle, to prevent it from throwing off the serum, and fermenting too much. The operation of churning should be performed slowly, otherwise the butter is injured.

If the cream is not separated from the milk, but the whole is churned together *, the milk is placed in coolers, till it comes to the temperature of the milk-house, say from 50 to 55 degrees of Fahrenheit; after which it is placed in vats, and allowed to stand, till as much is collected, as may be convenient for being churned together. The milk is never churned till it has not only become sour, but coagulated, or lappered, as the dairy term is. If a second meal of milk is cooled, before the preceding meal has become sour, they may be both put into the same vat; but if the first has in the least acidified, the other is put into another vat, that the souring may come on naturally; and the greatest care is taken, not to break the coagulum before churning. When that operation commences, the milk is raised from the temperature of the milk-house, to about 70 or 75 degrees, the proper heat for churning; and this is done by an admixture of hot water. If the churning is performed in less than two hours, the butter is injured.

Though butter intended to be used when fresh must be made with great care, yet that which is to be salted requires, if possible, still greater attention; and though salt is indispensable for that purpose, yet if the butter is properly prepared, and the salt properly mixed, the quantity required is not considerable. It is said, that the butter made in the months of May, June, July, and August, is the fittest for salting; and that butter made in the latter part of the season will not take salt so well †.

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* It is an immense advantage resulting from this practice, that the buttermilk thus obtained, furnishes such an excellent article of diet for the poor, and in particular for their children.

† Some prefer the harvest butter as sweeter, and not liable to become so soon rancid as the summer-made butter.

6. *Cheese-Making.*—This art cannot be altogether learned from books, yet such directions may be given, as may help to correct errors, or extend the knowledge of improved practices, and the introduction of discoveries. A few of these can only be briefly alluded to in this work.

Milk may be coagulated for cheese, either of the natural heat, as it comes from the cow, or it may be heated after being cold. The proper temperature for setting curd for cheese, is from 90 to 96 degrees. If coagulated at a lower heat, the curd is soft, does not readily part with the whey, and the cheese is too soft and inadhesive. And if the milk is too warm when coagulated, the curd is tough, and parts with too much of the butyraceous matter, along with the serum; and the cheese is also hard and tough.

In the English dairies, from an hour and a half, to nearly three hours, is allowed for the milk to coagulate, after it is mixed with the rennet. But in the Scotch dairies, the curd is generally formed in the space of ten minutes after the rennet is put into it; and if the curd were not set within the space of fifteen minutes, the rennet would be thrown away, and that of a better quality provided. When the coagulating substance does not operate within fifteen minutes, the milk cools too much; and when the time varies greatly, it is impossible to calculate the degree of heat, the regulation of which is a matter of considerable importance in making cheese.

In the English dairies, the curd is broken, or worked by two or three men, having their arms bare to their shoulders, and who continue to break it, for about forty minutes, before any of the whey is removed; but in the Scotch dairies, the curd is very gently broken, and slightly stirred by a single hand, for about the space of one minute, before the whey is begun to be removed. The whey is drawn off, as speedily as possible, without breaking, or pressing the curd too much, as that brings off part of the fat, and renders the cheese tough. In the English dairies, the curd is, after being freed of the whey, again submitted to a course of rubbing or bathing, before the cheese is formed; and next pierced to the centre with skivers, for some hours, by two or three persons. But in the Scotch dairies, these operations are unknown; the curd is not much rubbed, nor the cheeses skivered. In the English dairies, the salt is not mixed into the curd, but the cheeses are salted by rubbing them like bacon, or kipper, after the cheeses come from the press; while in Scotland, the salt is mixed with the dry curd, before the cheese is put into the press. After being salted, the English cheese is subjected to a sweating process, which is never resorted to in Scotland.

In order to make cheese rich, they sometimes mix fine tallow with it, and sometimes butter. The latter is practised in the northern parts of Scotland *. Sometimes also, farmers, in the northern parts of England, make what are called *egg cheeses*, which are famous for toasting. After the curd is thoroughly prepared, they make this cheese, by put-

* It might be better to withdraw a portion of the skim-milk and retain all the cream.

ting five yolks of eggs to every pound of curd, mixing the whole properly, and putting it into the cheese-press as usual. As to whey, it is sometimes used for making butter, sometimes for feeding swine or calves, and in the north of England, is sometimes prepared in the following manner: The whey is put into a kettle or pot on a smartish fire, and when it is near boiling, some butter-milk is put into it, which is skimmed off, as soon as any curd appears to be formed on the top of the whey. Some butter-milk is then again put in, and so on from time to time, as long as the curds will continue to rise. This substance is called *whey curds*, may be eaten with cream or milk, and is not unpalatable diet. The whey that remains from this curd, is commonly called *whig*, and when kept until it is sour, and two or three sprigs of mint put into it, many are of opinion that it makes a pleasant liquor, particularly in hot weather *.

7. *General Remarks on the Dairy.*—The accommodations and the apparatus necessary for carrying on a dairy, cannot here be minutely described. The cow-house, or byre, should be large, high in the roof, and well ventilated. The milk-house should be near to the cow-house, but kept free from the effluvia arising from the breathing of the cattle, their dung or their urine. It should be as much as possible protected from the sun, with its windows on the north side, covered with a grating of wire, to keep out mice, and that covered with gauze, to exclude flies. Slates or tiles make a bad roof for a milk-house, as the heat of the sun comes through them; and on that account, milk-houses should be covered with thin turf and thatch. No dungstead, or drain, or pool of water, or bulky herbage, should be allowed to remain near the milk-house. The dairy-house should be near to the milk-house, but so constructed, as to prevent the heat of the boiler, or the effluvia of the dairy from reaching the latter. The smaller utensils are too minute and too numerous to be noticed in this work.

It may be proper to add, that cleanliness is the most important ob-

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* It may be interesting here, to state the origin of two party distinctions, which have long agitated the political world, namely, *Whigs* and *Tories*, more especially as the first is connected with dairy husbandry.

The Tories were originally a race of freebooters in Ireland, who inhabited the mountainous districts in that country, and the friends to republican principles gave that name, by way of reproach, *to the Royalists*.

The appellation of "*Whigs*," on the other hand, was given by the "*Tories*," or royalists, to the Scots Covenanters, who were determined friends to a republican government. They were principally to be found in Ayrshire and the western counties of Scotland, and as they inhabited a dairy district, they lived much on milk and whey, or *whig*, as it was provincially called. They were frequently compelled however, from the scarcity of food, to come, with great bodies of horse, to purchase oatmeal at Leith, sent there, from the more productive arable counties on the eastern coast of Scotland. In 1648, they made an inroad into the low eastern districts, in one body, to the amount of 6000 horsemen, which was called "*The Whigamore's Inroad.*" The name was afterwards shortened into *Whig*.

It is singular that appellations, originally given as terms of reproach, should become designations, by which two great political parties, should afterwards feel a pride in being respectively distinguished.

ject to be attended to in the management of a dairy. If that be even in the slightest degree neglected, its produce will not prove either wholesome or palatable, nor can it turn out a profitable concern.

Conclusion.

I cannot conclude these cursory hints, without adverting to a most important subject, namely, the diseases of cattle, and the means of their prevention or cure, inquiries regarding which, are so well entitled to public attention and encouragement, instead of being left, as hitherto has been too much the case, to the desultory exertions of private individuals. The stock of domestic animals in a country, is one of the principal sources of its wealth, and every circumstance that materially tends to diminish their number, or to decrease their value, must be attended with much public loss. Animals are in general subjected to much fewer disorders than men, and as their diseases are of a much less complicated nature, they are consequently much more easily relieved. There can be little doubt therefore, that very moderate public encouragement, would be the means of discovering those remedies, that would be found the most effectual for their removal, Is it possible for the public money to be better bestowed? It is said, that a very effectual remedy for the rot in sheep, has been discovered in Holland, yet no pains are taken to procure a knowledge of it in this country, though that disease has, within these fifty years past, occasioned the loss of many millions of property, to the subjects of Great Britain. If that loss had not been sustained, would not the wealth of the country have been considerably augmented, its public revenue consequently increased, and of course, would not great quantities of human food have been preserved from destruction, which have perished, to the manifest injury of the nation?

No. XII.

COMPARISON BETWEEN HORSES AND OXEN, AS BEASTS OF DRAUGHT. BY SIR JOHN SINCLAIR.

THERE is no point that has been more keenly controverted, among both practical and speculative agriculturists, than whether horses, or oxen, are best calculated for the operations of husbandry. Bold averments have been made, and much acuteness displayed, on both sides of the question, without its merits being as yet finally decided upon. We shall endeavour to state the arguments on both sides, and the results which may be drawn from the information we have collected.

Those who approve of employing oxen in the draught argue, that they are purchased at from a half to a third part of the price usually paid for horses;—that they are subject to fewer diseases;—that while horses are liable to a number of accidents, and sudden disorders, by which great numbers are annually lost, oxen rarely suffer so as to prevent their being fattened, and disposed of to advantage;—that oxen increase in value about L.3 *per annum*, during the time they are wrought; while horses, after they are above seven or eight years of age, usually fall off in price, to much the same amount;—that as they are a more steady and regular draught than horses, they are peculiarly calculated for ploughing strong, stony or rough-swarded old grass land *;—that though it is better, to require only about two-thirds labour from them, yet, when properly fed, that they can execute nearly as much work, in the same space of time, as horses †;—that while horses require corn in proportion as they are worked, oxen need only a moderate quantity of turnips and oat straw;—that in a maritime country, it is essential, that seamen should be provided with beef of a *superior quality*, which can best be procured from oxen, *who have gradually*, under the working system, reached their maturity ‡;—and that while the horse is at last thrown into a ditch, and nothing recovered but his skin, the ox, after having laboured three or four seasons, will sell at from five to ten pounds higher, according to his size and condition, than when first subjected to the yoke §.

The objections to the use of oxen are as follow:

1. It is argued by those who are hostile to the use of oxen, that they are difficult to train, and on the whole less tractable than horses. This, however, is flatly contradicted by the advocates for the use of oxen, who maintain, that there is no more difficulty in training oxen than horses ‖;—that, when properly managed, they generally become sufficiently tractable, to be driven by a ploughman, without any other attendant, in the space of a few days;—that in all countries where the ox is the ordinary draught animal, his docility is proverbial;—that the want of success, in preparing oxen for the draught, is owing to inexperience, or has been occasioned by the obstinacy of servants, who will not take the trouble of training them;—and that any intractability, where it does exist, has arisen, from the animals having been only used occasionally with long and irregular intervals; during which the habit of discipline being broken, a new one is to be formed ¶.

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* Oxen move at a steady and persevering pace. In ploughing up old turf land, their motion in the plough being more steady than that of horses, the flag is less broken in turning over, which is a great advantage in the process of dibbling. Oxen also, being steady, and not easily alarmed, are greatly preferable for cultivating reclaimed bogs, in which horses would fret, and plunge, or stick fast altogether, whereas oxen would remain unalarmed.

† It is not fair however, to expect the same quantity of work, from oxen fed on straw and turnips, as from horses fed on corn and hay.

‡ The flesh of young, or half-grown cattle, never takes salt well.

§ All these arguments in favour of oxen, as applicable to turnip-land farms, Mr Walker of Mellendean, in Roxburghshire, approves of, after an experience of thirty-five years.

‖ Mr Walker of Mellendean asserts, that where the method is understood, oxen are as easily trained as horses.

¶ See an able paper on horses and oxen, by Mr Maddison, formerly President of the United States of America, printed in "*The American Farmer*," published September 3. 1819, from which several hints are here adopted. In that periodical publication, there is likewise some valuable information, from George W. Erving, and Timothy Pickering, Esqs. Indeed, the subject seems to have strongly attracted the attention of the agriculturists of America.

2. It is objected to the working of oxen, " that they do not bear heat so well." To this it is answered, that the objection is unfounded in fact. The constitution of the ox accommodates itself, as readily as that of the horse, to different climates. Not only in ancient Greece and Italy, but throughout Asia, as presented to us in ancient history, the ox and the plough are associated. At this day, in the warm districts of India and China, the ox, not the horse, is in the draught service. In every part of India in particular, the ox always appears, even in the train of her armies; and in the hottest parts of the West Indies, the ox is employed in dragging the weightiest produce to the sea-ports.

3. The next objection is, that oxen are slower in their movements, and cannot do so much work in a day as horses. This must in general be admitted; but in a less degree than is commonly supposed. Where oxen are well chosen for their form,—are not worked after they have reached their eighth year, (at which age they are best fitted to be fattened),—and are suitably matched, they may be brought to nearly as quick a step as the generality of horses, and to as quick a step as that of many horses, when they are aged, or ill-fed.

Horses, in England, plough about a statute acre of stubble in the course of the day;—oxen about three-fourths of that quantity. After various trials, these have been found about the average performances of each *. But in many cases, oxen have done more; and to accustom them to a greater quickness of movement, they should be trained upon light land, that they may acquire both a full, and a quick step.

4. It is further objected, that oxen, being weaker in the back than horses, are not so able to carry heavy burdens. But to that objection it is answered, that what they want in strength of back, is compensated, by the superior powers they possess in their neck. Hence their harness ought to be made, so that the draught should not be placed so much on their backs as that of horses, but chiefly on their necks, where their great strength lies.

5. It is next said, that oxen cannot bear extra work. This is a material objection, and the only one entitled to much weight, as the profit of a farmer, more especially in bad seasons, often depends on the getting his work done within a given time. In any unforeseen emergency, when a great pressure of work occurs, a horse may be fed up almost to any labour, however severe. But if an ox is pushed beyond his usual rate, he often sinks under his work, and is rendered useless for some time afterwards †.

Lord Somerville however maintained, that oxen are capable, not only of constant work, but of extra labour; and should a rest occur for a week or ten days, there is a profit attending their growth: this general profit, on an average, may be stated at twenty per cent. on their value; a circumstance much in favour of oxen ‡.

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* Curwen's Report, p. 78.

† General Report of Scotland, vol. iii. p. 203. But Mr Walker asserts, that by feeding oxen with *hashed oats*, he has made them do as much extra work as horses.

‡ Farmer's Magazine, vol. vi. p. 5.

The next objection is, that oxen are not calculated for the whole work of a farm. But here a distinction must be made between large and small occupations. Farmers who cultivate a great extent of ground, who pay full rents, and who live by their business, are almost universally of opinion, that the use of oxen alone would never answer, and indeed the total dismission of horses has been rarely thought of or attempted *. For long journeys, and distant carriages, oxen are considered quite unfit, for they must have time to ruminate †; nor can they well be employed, unless they are shod, either in frosty weather, or on rough and stony roads ‡.

In regard to small farms, the expense of purchasing and maintaining horses is a severe burden upon them; and though it may be desirable to have a horse to go to market, yet for the labour of the farm in general, oxen cannot be too much recommended §.

Another objection is, the loss of labour, on the part of the servant, where oxen are employed, which an eminent farmer calculates at from one-third to one-fourth of his wages ||.

The last objection to the use of oxen is, the great quantity of *good land* that would be required for their rearing and maintenance; whereas it is desirable, to prefer that species of stock, that would furnish the greatest quantity of labour, from the smallest quantity of fertile soil, beginning with the animal at his birth.

Minute calculations have been made to ascertain this point, which, on the whole, are in favour of horses, as they will work out, in all, three successive pairs of oxen ¶.

Independently of the same work being done by a much smaller number of horses, they have, in several other respects, advantages over oxen. 1. They are better fitted for harrowing, a quick step being requisite to accelerate the pulverization of the soil: 2. During the harvest season, when expedition is so indispensably necessary, horses are greatly to be preferred: 3. Oxen do not continue for any

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* His late Majesty George the Third devoted much attention to the cultivation of a considerable tract of land near Windsor. He used horses long enough to ascertain the heavy expense they work at, and he changed them *all* for oxen. It appears, that it required one hundred and seven oxen to do the labour of the farm. They were fed on hay and straw, for twenty-six weeks in the year, and on grass during the remainder. The saving by oxen was at the rate of L.513 *per annum*, besides the value of the oxen disabled by accident, difference in attendance, and fewer casualties.—*Annals of Agriculture*, vol. xxxii. p. 168, where the details will be found. The only doubt is, whether the horses were fed economically, and properly worked.

† Some maintain, that if oatmeal were given to oxen, it would enable them to undergo much longer journeys, and, in that respect, to approach nearer to horses. But still some rumination would be necessary.

‡ Lord Somerville asserted, that oxen could execute road-work, even of the severest nature;—but he afterwards admitted, that they were liable to slight strains and lameness, arising from travelling on such roads.

§ Farmer's Magazine, vol. xiv. p. 42.

|| If the wages of a farm servant, every thing included, is 2s. per day, it is maintained, that from 6d. to 8d. *per* day is lost, if he is employed in working oxen, instead of horses.

¶ General Report of Scotland, vol. iii. p. 198, where this point is minutely examined.

space of time in the possession of the farmer, seldom above three or four years from the time when they begin to be employed in the draught. They must, of consequence, be frequently bought and sold, which is attended with much trouble and expense; whereas horses will continue to work with the same farmer for several years, perhaps ten or twelve years from the time that they are first employed; and when they become unfit for severe labour, they are not thrown away, but can always be sold to higglers, petty carriers and others, to whom cheap horses are an object: 4. The use of horses in agriculture serves as a nursery for those wanted for the road, for pleasure, luxury, and amusement; and many farmers get their barrowing done cheaply by training up young horses, and giving them but slight work, until they are fit for the market *.

Conclusion.

We shall now proceed to state the results of the inquiry.

The great object of a farmer ought to be, to obtain that species of working stock, which is best calculated to perform all that routine of labour, which the soil, situation, and other circumstances of the land he occupies, may require †.

In former times, oxen were almost exclusively employed in the labours of agriculture, but they have long been gradually getting into disuse; and the custom not being re-established in this country, notwithstanding a heavy tax having been at one period imposed on horses ‡, from which oxen were exempted; it would be absurd to suppose, that there are not solid grounds for giving the preference to horses §.

It does not appear, that horses are superior to oxen in docility, or ability for works of various kinds; nor are they, in any respect, more hardy; but they are possessed of more general applicability to labour, from their conformation, agility, and better feet ‖. Hence, in all improved countries, since the labours of agriculture have become, not, as formerly, irregular and desultory, but uniform and constant, (more especially on high-rented farms, where the operations of husbandry are carried on with unceasing attention and industry), horses are preferred, as the best and principal resource, on which the farmer can rely for labour.

There are certain situations however, where a considerable profit may be gained, by employing *a proportion of oxen*, instead of horses, in agricultural labour. This profit principally arises from three

* Communications to the Board of Agriculture, vol. v. p. 364.

† Farmer's Magazine, vol. xiv. p. 275.

‡ The tax on horses employed in agriculture, ought certainly not to be extended to breeding mares. Even that exception would be thankfully received by the farmer.

§ The late Lord Somerville was the great advocate for oxen. He calculated, there were 600,000 plough and cart horses in England, one-half of them superfluous, while the land that would be required to feed a horse, he said, would support seven or eight human beings.

‖ Coventry's Discourses, p. 171.

causes: 1. An increase of manure;—2. A saving of food;—and, 3. Their improving in value, from the time when they begin to work, to the time of their being sold. They are likewise less subject than horses to sudden death, accidental injuries, and occasional maladies *.

The next points to be discussed, are, 1. In what description of farms a proportion of oxen can be used to advantage? and, 2. What the number of oxen ought to be, where they are admissible?

1. *Farms calculated for a Proportion of Oxen.*

Where oxen must be maintained with corn or hay, the feeding is so very expensive, that it cannot be advantageous to employ them to any extent.

In the neighbourhood of towns also, where straw, and every species of green food, as turnips, grass, &c. are higher in price than at a distance from them, the employment of draught oxen must proportionably be less profitable or advantageous †. On the other hand, there are few situations better calculated for oxen, than farms distant from market-towns, where putrescent manures cannot be purchased, but where turnips can be raised in considerable quantities, because that description of food is not only cheap, but is peculiarly conducive to their health and improvement. On turnip-land farms, they may likewise be employed, not only in ploughing, but in hoeing the turnips, in carting cut grass for soiling, and for other agricultural purposes about the farm.

But the best description of farm, for the use of oxen, is, where there is abundance of coarse and bulky herbage, favourable to the breeding of cattle; and where the land in occupation is so large, that there is a regular succession of ploughing, (unless in frosty weather), during the whole year ‡. On such a farm, oxen may be both reared, and advantageously employed as working stock.

2. *Proportion of Oxen on a Farm.*

In regard to this point, practical farmers, who approve of a partial use of oxen, do not materially differ. On one farm, where twenty horses would be required for the whole labour, the proportion adopted is, sixteen horses and eight oxen. On a larger farm, the occupier keeps twenty-two ploughs drawn by horses, and eight by oxen; and it is stated, that the proportion of oxen would be greater, were it not for the necessity of long journeys, or carriage of grain to market. But the most important examples on very large farms, were those of Mr Walker of Wooden, and Mr Walker of Mellendean, both strong advocates for the partial use of oxen. These gentlemen kept on their farms, fifty work horses and twenty-eight working oxen; and they calculated, that the expense saved on each plough worked by oxen, was

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* Farmer's Magazine, vol. xiv. p. 439. † Ibid. p. 434.

‡ General Report of Scotland, vol. iii. p. 203.—This observation, however, is not applicable to the fen lands of England, where keeping and working brood mares, for breeding dray and waggon horses, pays better than rearing and working oxen. Besides, on low fen land, (peaty), oxen cannot be reared in a healthy state, owing to the *scour* to which they are subject.

at the rate of L. 22, 15s. *per annum*, besides the annual increased value of the oxen *.

On all farms also, where the climate is precarious, and where, on that account, it is desirable to have some "*extra stock*" at command, oxen, being more cheaply maintained than horses, are entitled to a preference; and certainly may be advantageously employed in ploughing, in rolling, in carting dung or turnips, in thrashing mills, and for short carriages in general.

3. *General Remarks.*

1. It is advisable to begin working oxen, as early as two or three years old, but in such light work, and so moderately, as not to prevent their growth. It will then be easier to correct their faults and bad habits, which some are apt to get into.

2. They should always be worked with the collars reversed, that is, the broadest part uppermost.

3. Where a proportion of oxen are kept, those of a small size, or with light frames, ought to be avoided, for they cannot fully master their work, or be made to move expeditiously in the plough. Nor should they be selected for their great size; for in that case, they are soon exhausted by their own exertions. Those of a moderate size, whose form denotes superior agility and vigour, ought to be preferred. Oxen with short legs have likewise been found the best labourers †.

4. In the management of oxen, it is particularly desirable, (except during the depth of winter), that they should be worked in two journeys, or yokings in a day, that they may have sufficient time to ruminate in the interval. For that purpose, they should begin to work very early in the morning.

5. It is an excellent plan, to keep three oxen for each plough, and to work only two of these at a time, alternately. Thus each ox is only four days in the yoke every week.

6. A much greater proportion of labour on a farm might be done by oxen, if they were shod. When oxen are worked on hard stony roads, or obliged to go over rough frozen ground, they suffer severely from the want of shoes, and true economy requires that they should be shod as well as horses ‡. As yet, no shoe has been made in

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* Husbandry of Scotland, first edit. p. 113 and 114.

Sir Thomas Carmichael of Skirling, estimates that a pair of oxen is less expensive than a pair of horses, to the amount of L.27, 11s. *per annum*.—*Farmer's Magazine*, vol. xiv. p. 43.

† Mr Knight observes, that the more deep and capacious the chest, and the shorter and the lower any animal is, relative to its weight, the better adapted it will be to live and fatten upon little food, and the more labour it will go through. Mr Marshall also, in his Rural Economy of Gloucestershire, says, that the best labouring ox he ever saw, had the shortest legs.

‡ It is usual in some parts of France to shoe their oxen; and it is said that they have discovered in *New England*, some improvement in that branch of husbandry, an account of which it would be desirable to obtain. Mr Pickering has suggested to "*The Massachusetts Society for promoting Agriculture*," the propriety of communicating to the author, a drawing and description of the simple frame and apparatus, invented in New England, for the information of Bri-

Europe, that will enable oxen to walk with ease and safety on hard dry roads, or on frozen ground. The great difficulty in forming such a shoe is, that the iron must be divided, otherwise sand may get between the iron and the hoof, and create wounds and sores.

7. It is thought best, to begin to break in oxen at three years old, and to give them full work at four. In the northern counties of England, four oxen are commonly used, the two foremost in harness, the other two in yokes. In Scotland, it is not uncommon to work two oxen in harness, and without a driver. They are sometimes worked till they are from eight to ten, and even twelve years of age; but it is generally considered to be more profitable, to begin feeding them earlier.

8. Some people prefer free martins *, and spayed heifers, to working oxen. They are found very strong and active, and it is said they will, with equal feed, work nearly as well as a horse.

9. It was remarked by the late Sir Charles Turner, that the advantages of working oxen, depend much upon the breed; and he preferred the Lancashire sort, as they were not only active and hardy, *but lengthy in the carcase,* which enable them to go four inches further than almost any other kind.

10. The supposed necessity, of beginning to feed cattle at an early age, is a great objection to oxen being generally used, as they are hardly properly trained to labour, for the purposes of husbandry, before it is thought necessary to fatten them, after which they do very little work; but in consequence of the improved mode of feeding with oil-cake, &c. there is no difficulty in fattening oxen, even at twelve years of age, which is a material circumstance in favour of working oxen.

No. XIII.

HINTS ON TURNIPS, AND THE BEST MEANS OF PREVENTING THE RAVAGES OF THE FLY, *the Chrysomela Remorum,* LINN. BY SIR JOHN SINCLAIR.

There is perhaps no vegetable, from the introduction of which, the agriculture of these kingdoms has derived such essential benefits, as from that of turnips. They are not only of use as a fallow, for cleansing the soil from annual, and checking the growth of root-weeds;

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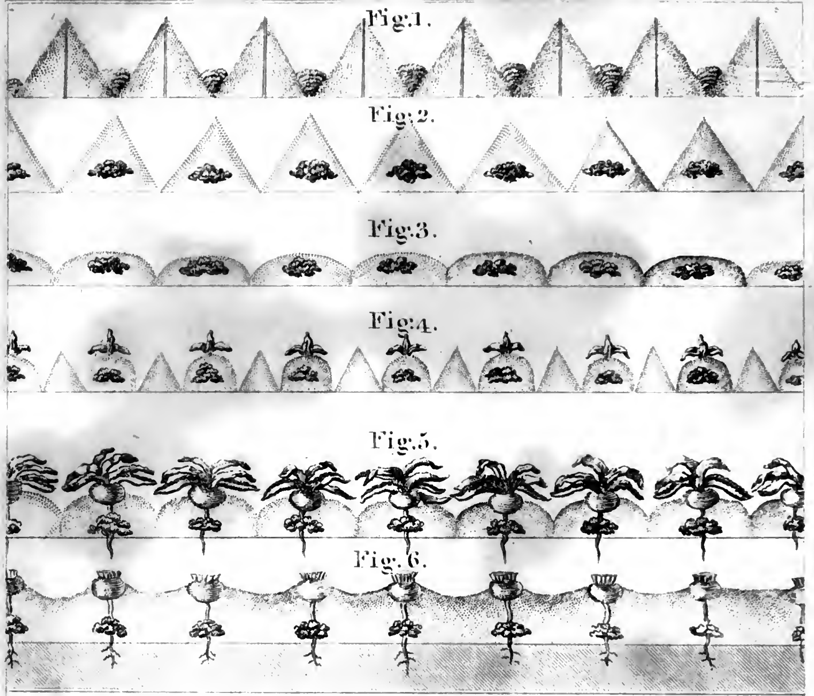
tish agriculturists; to whom, (as Mr Pickering with much liberality observes), "the farmers in America are so much indebted for instruction and examples, in the most approved practices of husbandry." (See "*The American Farmer,*" vol. ii. p. 139).—It is to be hoped, that such friendly feelings of reciprocal good will, will not only exist between *the farmers,* but will be felt by all the other classes in the two countries.

* Free martins are cow calves, cast at the same time with bull calves, which are never known to breed.

TABLE EXPLANATORY of the SCOTCH MODE of CULTIVATING TURNIPS in DRILLS.

Plate 6.



Scale of the Upper Figures 0 1 2 3 4 5 6 *Feet*

Fig. 7. *The Scale one Quarter of the Upper Figures.*

Neele Sculp. 352 Strand London.

but they yield a weighty and profitable crop, peculiarly calculated for the maintenance and the fattening of live stock and producing manure. It is a circumstance also, much in favour of the turnip plant, that in the latter stages of its growth, it is, in a great degree, nourished by the atmosphere, as well as by the soil, and consequently, less exhausts the fertility of the latter, than culmiferous or grain crops. The close and deep shade which the leaves of turnips produce, has a most advantageous effect in rotting all below them; while the quantity of putrescent manure, in a solid or in a liquid form, which they are the means of furnishing, is greater than what is obtained from any other article whatever. Under the improved system of turnip-husbandry, a more correct style of management is introduced, by which our fields are cultivated like our gardens; and various crops, in judicious rotations, are successively rendered highly productive, without any additional manure, (when sheep are fed upon them in the field), except what the turnips would produce. There is no crop, on the whole, the culture of which has been brought to a higher degree of perfection, or which contributes more, to increase the value of the land, or the amount of its produce; yet in many districts, possessed of light and loamy soils, and thence admirably calculated for the production of turnips, the farmers are often but little acquainted with the superior advantages of that plant *.

It is much to be regretted, that this most valuable article, is liable to be injured, and in many cases to be totally destroyed, by a small fly, or beetle, that attacks the young turnip, when just appearing above ground; at which tender period of their growth, the least puncture, in dry seasons, effectually kills the plant.

To prevent the ravages of this insect, various modes have been recommended, which may be arranged under the following heads: 1. Destruction of the fly;—2. Rendering the turnip less attractive;—3. Quickening its growth;—and, 4. Improving its culture †.

1. To destroy the fly, it has been recommended, to roll the land at midnight, while the dew is on the ground, by means of which, if the roller is heavy, the soil may be so compressed, that even these small insects may be crushed against the moist earth. Boards have been smeared with tar, and drawn across the land, for the fly to skip on them, and be caught;—a trap has been invented, by which considerable numbers have been taken;—train-oil and sulphur have been used with the seed ‡; quick-lime has been often suggested; and lime,

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* The proprietors and farmers of those districts of England or Ireland where this plant is either little known, or imperfectly cultivated, who would wish to introduce the turnip culture, *in its greatest perfection*, in their respective neighbourhoods, might easily effect that object, by procuring some farm labourers from Scotland, by whom, in all its well-cultivated districts, it is almost universally understood.

† See a letter written by an intelligent and public-spirited clergyman, the Rev. J. A. Rhodes, of Horsforth-hall, near Leeds: his letter is dated 29th July 1820, and was printed soon afterwards in the Farmer's Journal.

‡ In America they afterwards mix the turnip-seed with ashes, or pounded gypsum, which promotes a rapid vegetation; and it is asserted in that country

saturated with ammonia obtained in the preparation of gas, has been accurately tried, but all in vain.

2. To render the turnip less attractive, quick-lime has been used, sown when the dew was strong on the plants. The ground has been brushed with the leaves of the elder tree *. Turnips have been sown in the furrow, as well as on the ridge; and radish seed has been used in small quantities, the turnip-fly being particularly fond of the leaves of that plant.

3. The growth of the plant is quickened, by the application of a proper quantity of suitable manure, and placing it immediately under the plant, and where practicable, more especially in dry soils and seasons, the manure has been watered before it was applied.

4. The culture of the plant is improved, by sowing a great quantity of seed; also, by carefully weeding the crop, and frequently stirring the soil.

It is well known, where attention has been paid to the means of quickening the growth, and improving the culture of the plant, that the fly is not much to be apprehended. The plan of cultivating turnips *in ridges*, as originally practised by Mr Dawson of Frogden, in Roxburghshire, and now established with so much success at Holkham, will certainly, in a great measure, prevent the ravages of that destructive insect; but it is quite a mistake to suppose, that the plan is only calculated for such a soil and climate as that of Holkham, for it had long been previously adopted, not only in Roxburghshire, but in Berwickshire †, the Lothians, Northumberland, and other districts in Scotland and England. Still however, there are *ungenial soils*, as Mr Rhodes very properly observes, where it would be desirable to cultivate turnips, and where very strong measures, for the destruction of the fly, would be of the greatest utility. It is, doubtless, a fair field, on which chemistry may exercise its powers; at the same time, if security can be obtained by simpler means, it would be more desirable.

In looking over my notes on this subject, I find that other methods have been resorted to, for protecting the turnip crop, besides those enumerated by Mr Rhodes.

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that it never fails of success. For three seasons, steeping turnip-seed in train-oil, prevented the attack of the fly at Lord Orford's in Norfolk; but after being steeped in train-oil, *the seed was kept in salt pickle during the night.* Seven gallons of oil were found sufficient to prepare seed for 200 acres of turnips. *Annals of Agriculture*, vol. xiv. p. 168.—Perhaps neglecting these "*minutiæ*," (steeping the seed in saline pickle, or mixing the seed with pounded gypsum), occasioned the disappointment. Trials, with the addition of both these articles, ought to be made, by some public-spirited farmers.

* To insure the success of this application, the leaves of the elder should be a little bruised, and fumigated with the smoke of burnt tobacco, mixed with a small quantity of assafœtida. *Transactions of the Bath Society*, vol. i. p. 92, and 93. In this case also, *minutiæ* have been neglected. The dwarf elder has also a more pungent smell than the larger sort.

† The Reporter of the Husbandry of Berwickshire states, that during fifteen years' experience, he had neither seen nor heard of any misfortune from the fly, except in a few instances, owing to the drill system being there universally practised.—*See Report of Scotland*, vol. i. p. 558.

Some have recommended taking the seed of the same year, and of a former year, and mixing them together. Then to steep one-half of the seed, thus mixed, in water, for twenty-four hours, and afterwards to mingle the whole together. By this previous management, the turnips will rise *at four different periods;* and though the fly may destroy some of the plants, there will yet remain a sufficient quantity for a crop *, more especially if the quantity of seed used is considerable.

Mr Wigfull senior of Sheffield recommends, that twenty-four bushels of *the refuse* of kiln-dried oats, (called *shudes* in Yorkshire), or the same quantity of very dry saw-dust, or any other substance that will absorb a large quantity of moisture, (as fine earth in a dried state), shall be steeped for some days in putrid urine, and then mixed with eight bushels of soot, or of wood-ashes, and spread on the young turnips, as soon as they appear above ground; which, he is convinced, will preserve them from the ravages of the fly.

Mr Poppy of Witnesham, who has tried a number of these specifics for the destruction of the fly, found none of them effectual. He is convinced indeed, that the fly could draw the sap, and destroy the plant, without coming at all to the upper surface, by feeding on the inner and not on the outer part of the leaf; and with much ingenuity he has suggested the practice, of drilling alternately rows of common turnips and Swedes, the former very thick, to serve as food for the fly, and the latter thinner, to stand for a crop. Perhaps this plan, joined to Mr Sutton's mode of starving the fly, (to be afterwards described), might be successful.

An intelligent farmer in the neighbourhood of Edinburgh, (Mr Johnstone of Hill-house), always thins or pricks out his turnips *as soon as they appear above ground,* as they are certain of being in the *rough-leaf* next morning, and consequently out of danger †, a plan which may easily be tried.

A very great improvement in the cultivation of turnips, in dry soils, without any mixture of clay in them, is, by applying *a heavy roller* to the turnip drills, instead of the light ones commonly used. The reasons are obvious. The soil being thus thoroughly compressed, moisture is retained in it, and the gaseous effluvia, arising from the decomposing putrescent mass below, which nourishes the plants when young, not being suffered to escape too rapidly, which is often the case, their growth is promoted and quickened. The soil, also, being rendered perfectly smooth, the little vermin have no hiding places, in which they can shelter themselves.

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* Donaldson's Modern Agriculture, vol. ii. p. 313. As the latest and freshest seed will always spring up first, and the different portions of the mixtures will rise up at different times, the fly will naturally fasten on that which first appears; but when the second growth comes up, it will quit the first and attack the second; the same preference will be given to the third, and the fourth, when they respectively appear, the youngest being always the sweetest, and the most palatable. Before the last is finished, what remain of the former growths will be so far advanced, and will have so harsh and bitter a taste, that the fly will not return to them again. Thus a sufficient quantity of plants may escape for a full crop.—*General Report of Scotland,* vol. i. p. 560.

† Forfarshire Report, p. 363.—This proves that stirring the ground is of use.

Mr Church of Hitchill, an eminent farmer in Dumfriesshire, has ascertained, that it is the best mode of securing an early and regular vegetation, to sow the seed of the turnips *on moist dung*, as soon as it is spread in the drills, and afterwards to cover the dung by the plough, but not quite so deep as usual. This practice is highly useful in dry soils and seasons, and should never be neglected, where there is any risk of losing the crop for want of moisture. In a dry season, when the globe, and the Swedish turnips, did not vegetate till a month after sowing, and the crops, after all, turned out but moderate, the turnips produced by this plan attained a great size, (from 15 to 28 lbs. tops included), and many of them could not get larger for want of room in the drills *.

The following plan has been found an effectual method for insuring the destruction of the fly.

As soon as the ground is completely prepared for sowing the seed, let a quantity of stubble, straw, furze, dried weeds, heath, wood shavings †, or any other sort of cheap inflammable matter, be spread upon the surface, and burnt upon the ground, moving the flame forward, from time to time, and managing it, if possible, so that the smoke shall spread over the field. This is easily done in those dry seasons, when alone the fly is to be dreaded. As soon as that operation is completed, the seed should be instantly sown. The flame and smoke either kill the insects, or compel them to take shelter, if any crevice can be found in the soil, where they are likely to remain, until the young turnips are out of danger. The heat also, thus applied, and the ashes thus produced, are of some use to the crop. Nor does it require a great quantity of combustibles, to go over the field, merely for the purpose of destroying the vermin by the heat, the flame, and the smoke. It is probable, (though the quantity has not yet been ascertained), that from one to two tons of stubble or straw would be sufficient. The security of a crop of turnips would surely be cheaply purchased by such a sacrifice; and if stubble is used, the object can be obtained, almost without expense.

The practice of burning straw and gorse on the surface of the soil, as a means of manuring it for turnips, has long been practised in the Wolds of Lincolnshire ‡. In Dorsetshire, however, it has been

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* Husbandry of Scotland, 1st edition, p. 266.—This idea of sowing on the moist dung, is peculiarly calculated for the row culture of turnips, *not sown in raised ridges*. Let the surface be covered with rotten dung. When a furrow is made, rake as much dung as is necessary into the hollow,—sow, by a drill-barrow, the turnip-seed on the dung, and cover it slightly with the next furrow-slice. The crop is not then likely to suffer, either from drought, or from the fly.

† Mr Wigfull senior, in his remarks upon this plan, recommends, that deal and other wood shavings, should be collected from builders, joiners and carpenters, in the nearest towns and villages, and conveyed in bags where wanted.

‡ See Young's Report of Lincolnshire, p. 267. The quantity of straw used, when employed *as a manure for turnips*, was from four to five tons *per acre;* but much less would do, where spreading flame and smoke over the surface of the field is the sole object. It will only be necessary to use straw, for trying some experiments with burning; and if it succeeds, industrious farmers can afterwards find no difficulty, in collecting *as much stubble* as may be necessary, and stacking it in the field where the turnips are sown, so as to prevent the ne-

employed, *for the express purpose of destroying the fly, and with the greatest success.* The articles employed are burnt in the manner above described; and an intelligent friend of mine, who farmed in that county, has assured me, that it has succeeded on *alternate* ridges; and that the fly was destroyed where the burning was applied; but that where the burning had been purposely omitted, for the sake of an experiment, the crop was ruined.

Mr John Sutton of Fisherton, near Salisbury, Wilts, strongly recommends, taking all the previous steps necessary for the cultivation of the turnip crop, but not actually to sow the seed for ten days, or even a fortnight, after the ground has been thus prepared. He contends, that if the land is cultivated, and if the weather be warm and dry, the flies will be produced in vast numbers, having been disengaged, by the heat of the solar rays, from the eggs which contain them; and in that case, there being no vegetable sustenance for them, they will soon perish. The more therefore, that the land is turned up and cleaned, allowing a few days to elapse between each working, the more effectually will the destruction of the fly be promoted.

As soon as it is ascertained that the fly, thus brought to life, has been destroyed, the land should be *immediately sown*, without being again turned up, which might occasion another swarm of flies.

In a recent communication it is stated, that by following these instructions, many farmers in the neighbourhood of Salisbury have destroyed the fly.

If the soil, before the turnip seed was sown, were watered with a solution of sulphuric acid, the destruction of the fly would probably be effectually secured.

These experiments are strongly recommended to the attention of the diligent farmer; and indeed, if Mr Sutton's plan were followed, by the system of burning stubble, on the surface of the field to be cultivated with turnips, the depredations of the fly need not be apprehended, and could hardly ever take place.

The most recent discovery for preventing the destruction of the fly on crops of turnips, is made by Captain Barclay, who has ascertained that, in his part of Scotland, a mixture of bone-dust, and of common fermented manure, sown together, in the proportion of ten cart loads of farm-yard manure, to fifteen bushels of bone-dust, per Scotch acre, one-fifth less per English acre, insures a crop of turnips. The land is put in ridges in the usual manner, with the dung in the centre, and the bone-dust, in a pounded state, is sown with the turnip seed, by a drill machine. If five or six lbs. of seed per acre are sown in this manner, the crop can hardly fail. The bone manure brings the turnips so rapidly forward, that they are soon out of the risk of any attack from the fly, and the progress of the crop is, in other respects, greatly promoted. This is perhaps the most valuable application that can be made of bone-dust, and the quantity required is not considerable.

Mr Oliver of Lochend, a most respectable farmer near Edinburgh, having been peculiarly successful in the management of his turnip

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cessity of distant carriage at a critical period. By collecting weeds also, from the land, and even using sea-weeds on the coast, much benefit may be derived at a trifling expense.

crops, it may be proper to give a short account of the method he pursues.

The ground is prepared for the crop by three ploughings, though the number must, in a great measure, depend on the description of the soil, its state in regard to cleanness, &c. But in general three is considered to be an ample allowance, the first between the beginning of November and the end of December, the second, (when some farmers prefer cross ploughing), in April, and the third immediately before the turnips are sown.

The whole ploughings are given as nearly as possible of the same depth, which in general is about eight inches. When the second or third ploughings are deeper than the first, it is difficult, even by a pretty free use of the roller, to obtain so fine and equally pulverized a mould, as when the depth of the succeeding ploughing is regulated by that of the first.

The harrow and roller are used, just as often as may be necessary, to bring the whole soil stirred by the plough into a fine tilth, which depends much on the nature of the soil, its previous state, and the kind of weather during these operations. It is of great importance, that the land intended for turnips should not be in a foul state, because, when much cleaning is required, the farmer is often obliged to give more ploughings and harrowings, than are necessary, merely to produce a fine tilth; and by repeated turnings up, and long exposure, the land is apt, in dry weather, to become deficient in the moisture requisite to insure *a rapid and simultaneous vegetation of the seed*, an object of infinite importance. When the land is much infested with the roots of perennial weeds, persons must be employed to collect them, after the second and third ploughings; but that is seldom necessary, where a proper rotation is practised. The weight of the roller employed must depend on the state of the ground and weather. It ought always to have sufficient power, to reduce any hard lumps on the surface to a powder. Indeed, after the second ploughing, if the land can be allowed to remain for a week or more after that operation, before getting the last ploughing, a heavy roller ought to be used, being attended with two important advantages; 1. It prevents the too rapid evaporation of moisture; and, 2. It affords the best opportunity for annual weeds to spring up, which are all destroyed by the third ploughing.

The soil thus prepared, is formed into ridges, and the dung is deposited in the intervals between the rows. The dung is brought to the ground in single horse carts, or in tumbrils, and not in waggons, the wheels of which would destroy the ridges.

The quantity of seed sown is a point of great importance, not in general sufficiently attended to. It is proper to sow, more especially in a dry season, from six to eight pounds of turnip seed per Scotch acre, (one-fifth less per English acre.) When a multitude of plants are raised, there is a better chance that a sufficient number to produce a crop, will always escape the ravages of the fly. The value of the seed, on an average, being only about 1s. per pound, the expense of an additional quantity is no object, compared to the advantage of securing a crop. In favour of this rule also, it is to be observed, that when a large quantity of seed is sown, they assist each other in perforating the ground; consequently they grow more rapidly, and sooner get into a rough leaf, when they are safe from the fly, and may be thinned with advantage.

The general distance between the rows is from 27 to 28 inches, which, taking all circumstances into consideration, is as good an average distance as any other. Of course, circumstances frequently occur which may render it desirable to adopt either a smaller or a greater distance. Much less however, would seldom be found advantageous.

From 8 to 10 inches between the turnips in the row, is the distance to be preferred. At that rate the bulbs reach a considerable size on well-prepared land, and are of a more solid and nutritious quality than when exceedingly large, which would be the case on rich land, if allowed a much larger space between the plants. Much closer, they would be apt to be deficient in size for a full crop.

It is of great importance, to have new seed, that is, from the preceding year's sowing, as older seed vegetates more slowly, and produces weaker and less vigorous plants.

The seed should be steeped before it is sown, by which the light or defective seeds, which swim at the top, may be got rid of, and the plants will come up quicker, and more regularly.

The dung should be thoroughly fermented, by which the bulk is diminished, and it is more easily managed when inserted into the drill *.

Mr Oliver cultivates all the kinds commonly raised in the Lothians, and he considers a portion of each as best: the white for consumption in the months of October, November and December; the Scotch yellow for January and February; and the Swedish for March, April and May.

The general average on Mr Oliver's farm may be stated at about 40 tons of white, and 35 of Swedish and yellow, per Scotch acre, one-fifth less per English acre. In regard to the value of each sort for feeding cattle, there can be no doubt, that the Swedish is preferable to either of the other two; but they are more expensive to cultivate, from their requiring a greater quantity of manure. In many situations, that difficulty can hardly be remedied, and in some cases it is almost impossible. The introduction however, of rape-dust, bone-dust, and other light manures of a like description, has greatly lessened this material obstacle to the improved cultivation, and the greater extension of the turnip crop.

By a strict attention to these rules, Mr Oliver, who has been, for the space of twenty years, extensively engaged in the culture of turnips in East, West and Mid Lothians, never lost a crop, or indeed had any one materially injured by the ravages of the fly.

It may be proper to add, that there is no branch of the turnip husbandry, which requires to be more carefully attended to, than to se-

* When fermented dung is used, it ought to be moistened before it is inserted in the ground, for Mr Church of Hitchill has ascertained, that even in dry seasons, that would produce a rapid vegetation.

The addition also, of powdered gypsum to the seed, greatly promotes its rapid vegetation, and would contribute to prevent the attacks of the fly.

cure good seed. For that purpose, it is essential, that the farmer should either grow his own seed, or have it raised in the garden of some industrious labourer or small farmer, in his own immediate neighbourhood, and under his own eye. In a crop of such importance to the farmer, no trouble or expense ought to be saved, in securing the best seed that can be obtained; and though there are many seedsmen who may be relied on as to the seed they would furnish, yet in a matter of such infinite moment, the precautions to be taken cannot be too great.

It is earnestly hoped that the diligent farmer will avail himself of these hints, and will derive from them that benefit, to which his industry so justly entitles him.

2. *Hints on the Mangold Wurzel, or Red Beet, Beta Vulgaris.*

This plant is well calculated for feeding stock, and will thrive, not only on any land capable of producing good turnips, but on soils, as clays, where that root will not succeed. It is cultivated in the same manner as Swedish turnips, but it requires, from its shape, a greater depth of soil. The seed may be either drilled, or dibbled on the ridge. The ridges should be about 27 inches apart. The distance between the plants from 18 to 24 inches. The greater the distance, the larger will be the root, and the crop probably heavier.

Both the leaves and the roots are extensively employed in feeding milch cows, especially in the neighbourhood of large towns, and populous districts. Sixteen or twenty perches of land, cultivated with this plant will, it is said, support a cow, (allowing her at the rate of 60 pounds weight per day), for the five winter months.

This crop is considered to be much superior in value, to even a good crop of Swedes. It is likewise not liable to the attacks of insects;—it will stand a dry summer better;—it will grow a greater weight per acre;—it may be cleared from the ground early, and consequently stored with greater advantage.

On the other hand, it is, in this respect, greatly inferior to turnips, that the crop must be carried home, and not fed upon the ground, and that when cattle, horses or sheep are fed with them in winter or spring, if used fresh from the field, they must at first be given in very small quantities, and it will require at least a fortnight to increase them to the full quantity the animals ought to get. But, on the whole, the Norfolk farmers consider this plant as a great acquisition; and deem it highly advisable, every year, to appropriate a portion of the farm intended for the growth of turnips, to the production of this crop.

It is recommended, to sow per acre, from 3 to 4 lbs. of seed, and to mix with it half a pint of the seed of Swedes, for filling up the vacancies, in case the mangold wurzel should fail. The seed to be sown about the first week in May *.

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* See a short but able account of Mangold Wurzel, written by H. C. Blyth, Esq. of Deepdale, in Norfolk, inserted in Baxter's Library of Agricultural Knowledge, p. 333.

No. XIV.

ON BONES AS A MANURE, AND ON THE USE OF SEA-SHELLS, SHELL-MARL AND CORAL, FOR THE SAME BENEFICIAL PURPOSES.

Introduction.

THE use of bones as a manure, is perhaps the most important discovery, connected with the cultivation of the soil, that has been made in the course of a great number of years. By means of that discovery, and the improvements therewith connected, an end is put to every difficulty in producing *at home*, subsistence for the people of this country. We may thus be rendered independent of *foreign produce;* and unless our population were greatly to increase, we should be hardly able to consume, without the aid of exportation, the great quantities of corn that can be raised, under this improved system of production. It has become proverbial indeed, "*That one ton of German bone-dust, saves the importation of ten tons of German corn,*" and that agriculture is thus rendered in a considerable degree practicable, without cattle breeding, grazing, &c. Were the advantages of the discovery restricted to the use of bones alone *, as they might possibly be exhausted, or raised in price, it would be less important; but fortunately the shells of oysters, and other fish, are found to be equally effectual. Shell-marl also, which abounds in many parts of the kingdom, may be applied to similar purposes; and coral, the banks of which are abundant even on our own coasts, is found to be equally useful. In short, it is impossible to foresee, what may be the ultimate results of this new source of improvement, for by a small quantity of pounded bones or shells, great crops of turnips can be raised; and with the manure which these turnips produce, abundant crops of corn may be obtained, even on the poorest soils, with the aid of judicious rotations.

1. *Origin of the Discovery.*—The important discovery, that bones were an excellent manure, was made about the year 1766, by Anthony St Leger, Esq. a gentleman in Yorkshire, who had employed himself, for a great number of years, in a long course of speculative and practical agriculture, and more especially in making experiments with almost every species of manure †. Dr Darwin mentions it in his celebrated work on agriculture, "*The Phytologia* ‡." It is likewise briefly noticed in Sir Humphry Davy's lectures §. But it was not until the year 1828, that it attracted much public attention, when, by the exertions of an active and public-spirited body, (the Doncaster Agri-

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* The importation of bones ought to be encouraged by a public bounty, and some allowance given to the captains of vessels, who bring bones as ballast in their ships.

† The first account of this manure, was published in Dr Hunter's Georgical Essays, vol. ii. p. 93.

‡ See Sect. 10. 5. 5.

§ Page 252.

cultural Association), much useful information, regarding the advantages of this great discovery, was collected and published *.

2. *Chemical Analysis of Bones.*—The composition of bones, according to Berzelius, is as follows:

	Dry Human Bones.	Dry Ox Bones.
Phosphate of lime,	51.04	55.45
Carbonate of lime,	11.30	3.85
Fluate of lime,	2.	2.90
Phosphate of magnesia,	1.16	2.05
Soda, muriate of soda and water,	1.20	2.45
Cartilage,	32.17	33.30
Blood vessels,	1.13	

3. *Manner in which the Manure operates.*—It is difficult to comprehend, how so small a quantity of manure, as that employed when bones are made use of, should produce such astonishing effects. But the enigma has been thus explained. Though the plants receive but a small portion of benefit from the bone manure itself, yet by means of that manure, strong young plants are produced, which are thus rendered capable of extracting nourishment, from the substances in which they are placed, and from the surrounding atmosphere. These are acquisitions, the power of obtaining which, sickly or stunted plants do not possess. By the same healthy nourishment, obtained in small quantities during the progress of their growth, the plants are kept in a constant state of improvement. They are thus enabled to absorb the surrounding organic matter, to increase in size, and ultimately to reach their full weight, and utmost perfection †.

4. *On the Soils for which Bone Manure is adapted.*—On light dry soils, bone manure is peculiarly applicable, and it has likewise been found highly advantageous on peat. From 15 to 20 bushels of bone-dust per statute acre, when drilled, have been found to surpass, both on light soils, and on peat, the ordinary dressing of farm-yard dung, and even to exceed pigeons' dung and lime in producing fertility. In wet stiff land on the other hand, the nutritive part of the bones is apt to remain on the surface, and does not so readily mix with the soil as in ground of a freer quality. If previously mixed however, with other manure in compost, it might be advantageously applied, to every species of soil, whether wet or dry, and perhaps, in many cases, might render fallows unnecessary.

5. *On Composts with Bone.*—It is a circumstance that seems to be well ascertained, and the practice is strongly recommended by the Doncaster Association ‡, that a compost of bones, with dung, or other substances, is superior to bones used singly. Various substances have been employed for that purpose, as six loads of farm-yard manure, to ten bushels of bone-dust;—a quantity of ashes from house fires moistened with urine;—five loads of burnt clay, or good earth, mixed with fifty bushels of bones;—a compost of soot, rape-dust, red ashes from burnt weeds, &c.

* The association appointed a committee, to make inquiries regarding the use and advantages of bones as a manure; and the Report of the Committee of that respectable Association, (which contains much valuable information on the subject), was published by Ridgway, London, in 1829.

† Quarterly Journal of Agriculture, p. 52.

‡ Report, p. 20.

This circumstance merits particular attention, for bones in wet weather do not act, whereas if composts are applied with bones, some of the articles employed will operate; and when the land becomes dry, the bones will probably take effect, and the crop will hardly fail in any season. When employed in compost also, the manure may be more equally spread, and more confidently relied on.

Captain Barclay uses a mixture of bone-dust, and farm-yard manure, in the proportion of ten loads of farm-yard manure, to fifteen bushels of bone-dust *per* Scotch acre. He puts the land in ridges in the usual style, with the dung in the centre, and the bone-dust is sown with the turnip-seed, by a drill-machine. Under this excellent system, his crops are never injured by the fly. It is important however, that the dung should be two years old, as it will be less likely to be infested with insects.

Others recommend a dressing of eight cubic yards of ashes, and twenty bushels of crushed bones *per* acre, applying them separately. The ashes would first operate, and the bones would complete the production.

On the various modes of preparing Bones.—Mr St Leger, who originally pointed out the advantages of bone manure, was accustomed to mix a cart load of ashes, with thirty to forty bushels of bones. After they had been heated for about twenty-four hours, and begun to smoke, the whole heap was turned, and about ten days after it became fit for use. Others have found, that covering bones with quicklime, is an excellent mode of preparing them for use. As soon as the lime becomes effete the bones are picked out, and though retaining their form, they are easily reduced to powder by a hammer, and in that state, they may be thinly spread by hand, or by a machine *.

Dr Fenwick of Durham, an eminent agriculturist, has suggested to the author, the adoption of the following plan: Where there is no mill to crush bones within a reasonable distance, after chopping the bones, he recommends spreading them between two layers of earth, near a pond, or other supply of water, and to let the heap thus formed, be kept moist, by occasionally sprinkling it, till the manure be wanted. Fresh soils, thus mixed with bones, and watered, will heat as a dunghill, and the bones will be rendered so tender by the process, that they are quickly dissolved. As the whole substance is thus sooner applied to the plants, a smaller quantity at a time will suffice, and thus the first outlay will be diminished. The bones wanted for turnip manure, may be thus prepared, even some months before they are wanted.

But the general mode of preparing bones for use, is by crushing them. Bone mills, for that purpose, erected at an expense of from L.100 to L.200, are very common in the northern parts of England. They are chiefly in the hands of persons who make a trade of it. They are mostly driven by steam engines of from eight to sixteen horse power. Some machines however, are driven by water, and some by horses; but it requires three relays, of two horses each, to reduce

* Oyster shells have been advantageously treated in the same way, and have proved fully equal to bone-dust.

eighty bushels of rough bones *per* day; and farm horses have so much to do, in carrying on the operations of the farm, that they have work enough, without being employed in crushing bones. It is better therefore, that this process should be undertaken by a separate profession.

7. *On the proper size of Bone Manure for quick profit.*—A decided preference is given to bones broken small, and they are frequently reduced to powder of the size of saw-dust. Indeed, the more they are divided the more powerful are their effects. But if it is desired to keep the land *in good heart,* the size should be about half an inch.

When the bones are broken to a small size like dust, twenty-five bushels *per* statute acre are sufficient, but forty bushels are required, if the size of the bones is from half an inch to an inch.

8. *On fermenting Bones.*—It can hardly be doubted, that fermentation is necessary to a speedy benefit from bone manure, for when unfermented, though laid on at the rate of even eighty bushels *per* statute acre, they have at first little effect on the soil. Hence it is that bones, though in consequence of their being boiled or stewed, and passing through an oil or glue manufactory, have necessarily lost some valuable parts of their substance, *yet having been fermented,* they are preferable to those in a raw state *, the fibres of the turnips, or of any other plant, taking hold of them sooner, after the oleaginous part, which impedes their decomposition, has been taken from them. It is in consequence of their being heated, that bones are rather improved in utility, by their being kept in a great body on board a ship, either when imported from other countries, or conveyed at home from one port to another. Bones however, in a raw state, are superior in point of duration, to those which have undergone any manufacturing process.

9. *On the Advantages of Bone Manure, applied to arable land.*—In the cultivation of arable land, bone manure is generally employed for the turnip crop.

This is productive of numerous advantages; the use of this manure, diminishes labour at the season of the year, when time is of the greatest importance, for one waggon load, containing a hundred and twenty bushels of small bones, fit for the drill, equals from forty to fifty cart loads of fold manure.

Its suitableness for the drill, when converted into dust, and its great fertilizing properties, render it peculiarly valuable in those parts, where, from the distance of towns, or large villages, it is impossible to procure manures of a heavier and more bulky description. It is evident, that there can be no seeds of weeds, or larvæ of insects in bone manure, which is generally the case in farm-yard dung.

It is an immense advantage, (if bones are properly used), that a severe drought will not prevent a crop of turnips, even in seasons when all other manures will fail. A number of valuable animals are thus preserved from perishing, and manure obtained for the succeeding crops in the rotation.

When bones are used, the farmer is but little troubled with the fly or beetle, so injurious to turnips, for as soon as the plant reaches the bones, they immediately get into the rough leaf, and no fly touches

* Doncaster Report, p. 9; also p. 22.

them; whereas with dung, particularly if it is only one year old, the fly is generated, and in dry weather, the continued sunshine matures them, and from want of rain or cool weather to thin them, they come into action in great numbers, and destroy the young plant *. It has also been remarked, that the disorder, called fingers and toes, has been less prevalent since bone-dust has been in use.

Turnips raised by bone-dust, are said to be superior in quality to those produced by any other sort of manure. They also remain quite green, when the same crop, laid down with other dressings, is entirely destroyed. The roots also, are quite of a different quality, being much firmer, and more nutritious, while the succeeding barley ripens earlier, and is increased in quantity. The succeeding crop of clover also, is said to be improved in the same proportion.

In thin sandy soils, with a gravelly subsoil, if rape dust be used, it is often washed away by rain, and in very hot and dry seasons, the strength and virtues of dung are apt to be evaporated. But in all seasons, and under all circumstances, bone manure is found to be productive.

Bone-dust as a manure may, with comparative ease, be applied to lands at a great distance from the home-stead, or of difficult access; also in situations where the surface is broken by rocks, or so steep, as to make it difficult to cover dung, (where it is used) in the drills.

Turnips however, produced by bone manure, should be consumed on the ground by sheep, to prepare it for the succeeding crop of corn, as the effect of such a small quantity, cannot be supposed to continue through successive crops; but if any part of the turnips be removed, care should be taken, to clean them well when taken up, otherwise the small particles of bones, which are found invariably adhering to the roots, would be carried off the land †.

It is an immense addition to all these advantages, that when this extraneous manure can be made use of, the dung produced on the farm, not being required for the turnips, can be advantageously applied to the other crops in cultivation.

The following is a comparative statement of the expense of manuring an acre of land with bone-dust, and with dung, allowing forty-five imperial bushels of the former, and thirty tons of the latter, and supposing the distance of the farm, from the place where the manure is supplied, to be five miles.

To 30 tons dung, at the low price of 5s. *per* ton,	£.7 10 0	
Cartage, tolls, &c., for 30 carts, at 2s. 6d. *per* cart,	3 15 0	
		£.11 5 0
To 45 imperial bushels of bone-dust and drill, average price 2s. 8d. *per* bushel, - - -	£.6 0 0	
Cartage, &c., one cart, - - - -	0 2 6	
		6 2 6
Additional expense of an acre manured with dung, compared with one manured with bones, - - - -		£.5 2 6

* Doncaster Report, p. 9 and 10. † Hints from Mr Grey of Millfield.

The above great inferiority of cost, when taken into consideration, with the very great difference of labour, and the greater richness and durability of bones as manure, over dung, form a very striking contrast indeed.

10. *On the Advantages of Bone Manure applied to grass lands.*—On grass, bones should be sown in the state of powder, in autumn, by the hand, or if the quantity allowed is small, early in the spring *; but previous to its application as a top-dressing, the five coulter cutting plough, or scarificator, should be employed to open the ground. The manure has thus a more speedy influence upon the grasses. There is less waste of it, and its effects are more beneficial and complete, than when it is merely thrown upon the surface, and left to work its own way, without any such assistance. When thus managed, bones have a greater effect on grass lands, than even on arable †. The cows pastured on lands thus manured, are so much improved in condition, that they will produce about twice the quantity of butter, than when feeding upon land of similar quality, but not boned; and the pasture, in regard both to quantity and quality, is greatly ameliorated for a number of years. When the field is in hay, the crop is likewise more abundant,—the after-grass more nutritious,—and the herbage it produces is so peculiarly sweet, that cattle and sheep will hang upon it, as long as they can find a blade of grass to devour ‡.

But we are told, that bone manure is an article that may be exhausted, and that a supply cannot be confidently relied on. That idea however, cannot be admitted. Bones might be brought, even in considerable quantities, *in ballast*, from the most distant countries; and from the Brazils, where cattle are so cheap, as to be killed for the sake of their hides alone, the supply would probably be abundant. Besides, there are many other substances, as horns, the shells of sea-fish, coral, and shell-marl, which may answer the same purpose, and the produce of which is perfectly inexhaustible. Horns are found to be a more powerful manure than even bones, for they contain a larger quantity of decomposible animal matter, but being much used in various manufactures, their shavings or turnings alone, are applicable to agricultural purposes; and though they form an excellent manure, yet they are not sufficiently abundant to be much used. They are sown by the hand, as a top-dressing for wheat, and other crops §.

Shells of Sea-Fish.—As bones are likely to become rather a scarce article, it may be difficult to supply them in quantities adequate to the demand: it is a most fortunate circumstance therefore, that the shells of oysters and other sea-fish, when properly reduced in size, have been found equally useful as a manure. Their utility would be much increased, if they were sprinkled with sulphuric acid, by the addition of which they would be converted into gypsum.

* If bruised bones were used, they might interrupt the progress of the scythe.

† Doncaster Report, p. 14.

‡ Worgan's Survey of Cornwall, p. 130.

§ Davy's Lectures on Agricultural Chemistry, p. 253.

Shell-Marl.—Among the articles that may be used in aid of bone-dust, there is none better calculated to raise abundant crops of turnips, than shell-marl. It consists of calcareous matter, the broken and partially decayed shells of fresh-water fish, found often in morasses, and at the bottom of lakes and ponds. It possesses great stimulating properties, and is highly beneficial in fertilizing the soil. There can be no doubt therefore, that it furnishes the means of producing various crops, and turnips in particular, if employed in the same way as bone-dust, namely, inserting it into the drills, with the turnip seed. There is every reason indeed to hope, that its growth would thus be rendered so rapid, as to prevent the attacks of the fly. The field should be put in drills, in the usual style; a moderate quantity of fish manure, or fermented dung, say at the rate of two tons *per* acre, put in the centre of the drills, and the turnip seed and shell-marl, mixed together, sown by a drill machine above the fish or dung.

By this simple process, immense crops of the Swedish, as well as the common turnip, might be obtained; and perhaps that still more valuable plant, the Mangold Wurzel, might likewise be successfully cultivated.

The addition which this plan would make, to the value of the counties of Caithness, of Forfar, and other districts in Scotland, where shell-marl abounds, is hardly to be credited.

Corals.—If every other substance of a similar quality were to fail, it is a fortunate circumstance, that corals might be obtained in inexhaustible quantities. Banks of them have been found in some of the Western Islands of Scotland, and in the parishes of Southend in Argyleshire, and of Loch Broom in Ross-shire. It is well known, that corals are of animal origin, and wherever they have been tried, their effects have been highly gratifying.

Conclusion.

By these important discoveries in the art of agriculture, an end is put, to all the fanciful divisions of our soil, by political economists, into a certain number of zones, according to their supposed fertility. All these zones, by means of these discoveries, may be rendered equally productive. Already, it has been completely ascertained, that, by means of bone-dust, the poorest, coldest, and most humid lands, in various parts of England, have been brought into the highest state of cultivation, and improved in regard to their produce and intenseness of fertility. It can no longer be doubted, that, by means of bones, and the other substances above enumerated, the coldest clay, and poorest heaths, may be rendered productive.

A foreign agriculturist, astonished at the immense exportation of bones from the Continent to England, instituted some comparative experiments, the results of which prove, that bone-dust acts in the cultivation of grain, when compared to the best stable manure,—

1. In respect to the quality of the corn, as ....7 to 5
2. In respect to quantity, as ....5 to 4
3. In respect to durability of the energy of soils, as..............3 to 2

It is a strong argument also, in favour of bone manure, that it is found to benefit, not only the particular crop to which it is applied, but that it extends its influence to the succeeding ones, and that, even in the following courses, its effects are visible, in the improved quality of the soil, and the efficiency of a smaller quantity of bones, than was at first necessary to insure a crop.

It may be proper to conclude this interesting inquiry, with some general remarks on the utility of manures.

It has been justly observed, that all vegetables, naturally incline to that state in which they existed, when sown and produced by the hand of nature, without any artificial aid; and that the great objects of agriculture are, 1. To keep up vegetables in that *unnaturally luxuriant state*, in which they are brought by cultivation; and, 2. To preserve their health, and distinct character and properties, while they are in that state. For these important purposes, the application of manures is necessary. It is not essential however, that the manure applied should, in all cases, be sufficient to maintain that unnatural luxuriance of the plant, which it has acquired in the course of its cultivation, for many plants, in particular turnips and potatoes, draw nourishment from the atmosphere as well as the soil, and consequently do not require the same quantity of manure, as in the case of corn, where the growth of the plant, in a great measure, depends upon the fertility and richness of the soil *.

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* See some ingenious observations, entitled, Remarks on Manures, and on the Action of Ground Bones on Plants, and the Soil.—Quarterly Journal of Agriculture, No. I. p. 43. Mr Mason of Chilton tried the following experiment: " He applied forty bushels of bones, broken small, with eighty bushels " of burnt soil, to one acre, and to an acre immediately adjoining, forty gallons " of unrefined whale oil, (which cost 8½d. per gallon), mixed with one hun- " dred and twenty bushels of screened oil." This last mixture was made one month before it was used. The result was, that the soil and oil gave him at the rate of 23 tons, 5 cwt. 6 st. per acre, while the bones and burnt soil produced 21 tons, 18 cwt. 6 st. per acre, making therefore, a decisive difference, in favour of the fine earth and oil. See the Doncaster Report, p. 30.

The attention of the spirited farmer, to this important experiment, cannot be too strongly recommended, for oil would be a much more accessible species of manure than even bone-dust, and could be had in greater qnantities, and at a cheaper rate.

The want of an experimental farm, to try the effect of such experiments as these, is deeply to be lamented. In the interim, it is highly desirable, that *agricultural associations* should endeavour to supply the deficiency, by a diligent inquiry into the practices of different farmers, and a publication of the most important improvements, which they have respectively discovered. This is an advantage, which has not hitherto been obtained to the extent it ought, owing to the attention of the public, not being hitherto sufficiently called to the immediate and extensive advantages which would result from habits of inquiry. Hence, owing to the want of communication and intercourse on practical farming subjects, the improvements adopted by one farmer, are unknown, even among his nearest neighbours. It is next to impossible, that hundreds and even thousands of intelligent men, should be in the practice of directing and superintending agricultural operations, without making some improvements in their method; and it cannot be doubted, that the advantages accruing from the improvements they have discovered, might be made equally available to all

No. XV.

ON THE CORN LAWS

By the Right Honourable Sir John Sinclair, Bart.

Introduction.

THE celebrated Sully, calls agriculture one of the breasts from which the state must draw its nourishment. That great man, could not possibly have given us a more happy simile. Instructing by precepts, and stimulating by rewards, he prevailed upon his countrymen to cultivate the art. But their attention to this branch of industry was of short duration. Public troubles arose, which soon put an end to arts, agriculture, and commerce.

Colbert adopted a different notion of policy. Esteeming manufactures and commerce as the sinews of the state, he gave all possible encouragement to the artizan and the merchant.

The farmer being discouraged, the necessaries of life became dear; —the public granaries became ill stored;—manufactures languished; —commerce drooped;—the harvest became scanty;—and in a short time, industry fell a sacrifice to the ill-judged policy of the minister.

Two systems are therefore recommended to our adoption, the agricultural, and the commercial.

Let us consider the principles of both, and we shall soon be able to judge which is entitled to a preference.

I. *Principle of the Agricultural System.*

" That the country shall not become too habitually or extensively " dependent, for the subsistence of its people, on foreign supply: That " as a check on such a ruinous dependence, no foreign corn shall be " admissible into the British market, until the price of grain shall " denote a risk of scarcity, and then, that such foreign corn shall be " liable to such duties as may secure the British farmer from ruin, by " his receiving a price for the produce he has reaped, that will in " some degree compensate for the deficiency of his crop. Hence, " that to a certain point, (say 60s. per quarter), he ought to enjoy a *mo-* " *nopoly*, and to a second point, (say from 60s. to 74s. per quarter), " he shall receive *protection*."

This has for many years been the principle of the corn laws of England, and, after much deliberation, has been adopted in France.

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other farmers. But unfortunately, from the seclusion connected with a life, entirely devoted to the pursuits of agriculture, individuals are not led, by the great impetus of self-interest, to make their improvements public; on the contrary, they are frequently inclined to conceal them. This great deficiency can best be supplied, by means of agricultural associations making a diligent collection of facts, and communicating them for the public benefit.—See the valuable Report of the Doncaster Association, p. 32.

II. *Principle of the Commercial System.*

" That *at all times,* and *from all countries,* corn shall be admis-
" sible into Great Britain and Ireland: That there shall be no re-
" straint whatever, either in regard to the country whence the corn
" shall be brought, or to the shipping in which it may be conveyed:
" In short, that *the trade shall be free,* in regard to the mode of con-
" veyance, and shall not be liable to any duty on importation."

III. *Arguments in favour of Agriculture, and a Refutation of the reasons urged in favour of the Commercial System.*

1. That *the territory of a country,* is the only sure and permanent basis of national prosperity, and the fund, which it is both our duty, and our interest, as much as possible, to cultivate and to improve.

2. That if adequate protection and encouragement be given to the cultivation of the soil, its produce, in Great Britain and Ireland, (unless in seasons peculiarly unfavourable), will be fully adequate to supply their inhabitants with food.

3. That if the principles of free trade are admissible in regard to other articles, they ought not to be acted upon in regard to corn; because a dependence on other countries *for food,* is in the highest degree dangerous, and may be productive of the most fatal calamities.

4. That if we depended upon foreign governments for food, they would naturally be induced to impose taxes on the exportation of grain, to enrich their own exchequers, which Prussia actually did in the year 1801 *; and that those foreign countries whence we derive our supplies, may have deficient harvests, in which case, the governments of those countries, may be compelled to prohibit exportation, to prevent their own subjects from being reduced to distress, in which case Great Britain would suffer all the calamities of famine.

6. That any great dependence on foreign countries for food, would be highly dangerous if a war broke out, by which any regular supply of corn might be prevented; and even if we preserved our naval superiority, we might be unable to protect our trading ships in all quarters of the globe, more especially since the discovery *of steam navigation,* for it would necessarily become a most important object to our enemies, to prevent our being supplied with grain, as a sure means of reducing us to submission †.

7. That although an insular situation is favourable to a supply by navigation, yet it is exposed to many hazards, in particular to tempests, and "*the caprice of the winds and the waves;*" so that a regular supply, for many weeks and even for months, might be retarded.

8. That the home market is by far the most favourable for the sale of our manufactured goods, and that no instance is on record, or can be produced, when agricultural produce was at a fair, liberal, and

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* See the Report of the Agricultural Committee, p. 479.

† It was a famine in France, that compelled the government of that country, to agree to an unfavourable peace at Aix-la-Chapelle, on terms, to which otherwise it would never have acceded.

adequate price, that the home trade of the country did not consequently flourish *.

9. That successful agriculture is highly advantageous to commerce, because a large proportion of the goods imported, is for the consumption of the agriculturists; and that it is much more for the interest of commerce, to have rich customers at home, than persons so impoverished, that they cannot afford, either to consume great quantities of goods, or to give an adequate price for the few they can purchase.

10. That the importation of foreign corn, *in foreign ships*, must be highly unfavourable to British commerce and navigation: That corn is in general imported from poor and thinly inhabited countries, which do not require British commodities in return: That poor countries require the precious metals, either to purchase foreign commodities, (as wine from France), or to provide a capital, with which they may erect domestic manufactures for their own supply. Those British manufacturers therefore, who wish to promote the importation of foreign grain, lay a foundation of future rivalship against themselves.

11. That successful agriculture is always favourable to the increase of the revenue, and that the revenue is never so productive, as when agriculture is in a prosperous state.

12. That the real strength and stamina of a country are to be found in the cultivators of the soil. In the words of the celebrated Chatham, " these genuine sons of the earth are invincible." They are the best calculated for acquiring military glory abroad, or securing the safety of the nation at home. That every wise government must be anxious to increase, and not to diminish the numbers, of so valuable a class of the community; and with that view, not only to preserve in a productive state, its lands already in cultivation, but to add to their fertility and extent.

13. That the most erroneous accounts have been given, of the number of persons who, directly or indirectly, depend on agriculture for their subsistence: That if a careful inquiry were made, it would appear, that two-thirds of the population in the united kingdom, including those manufacturers who raise goods for the home market, derive the means of their subsistence from agriculture.

14. That the class of persons who are principally interested in the corn trade, are commission merchants, to whom foreign corn is consigned for sale in the British market; and it is to promote their interests, that the nation has been so long kept in a perpetual state of agitation, on the subject of the corn laws.

15. That if the importation of foreign corn be encouraged, not only is the extension of agricultural improvement checked, but a large proportion of the territory of the country will be driven out of cultivation, and perhaps a million of persons deprived of their usual means of subsistence. The poor rates will then absorb a still greater proportion of the rents of the country, and the owners and occupiers of

* See Alderman Rothwell's evidence before the Agricultural Committee, Report, p. 87. He well observed, " That agriculture ought to be considered " the very staple of the country; and that protecting duties of agriculture, were " for the benefit of trade."

the soil in England, with such an addition to their burdens, will be reduced to beggary.

16. That it is in the highest degree impolitic, in regard to so essential an article as food, to prefer the interests of the consumer, to that of the grower; for that it is not a temporary interest that ought to be kept in view, but one of a lasting and permanent nature: That if the whole globe were ransacked for cheap food, it may be obtained for a short period; but that, in the course of years, a nation will be supplied with grain, both cheaper and better, by promoting domestic agriculture, than by depending on foreign importation.

17. That cheap corn is not favourable to industry, it being well known, that in manufacturing towns, there is more regularity of conduct, and more productive industry, when corn is at a medium price, than when it is unusually low: That manufacturers in general are more likely to be happy and industrious, when they pay a fair price for their food, than when it is too cheap *. When manufacturers can gain their livelihood by the labour of four days in the week, they often spend, the three remaining days, not only in idleness, but also in dissipation, to the injury of their health and morals.

18. That it is a most dangerous maxim, "*Import goods, and you* "*are sure to export;*" for you must pay for the goods you import, but you may not be paid for the goods you export, or the price may be so low, that no profit will be derived from it. Besides, when we get corn from abroad, we import the labour of men, and in return, we export the labour of machinery.

19. That the idea of abolishing all restrictions on the commercial intercourse of nations, is visionary and absurd: That notwithstanding every effort to preserve peace, national jealousies will arise, and wars are inevitable: That under the proposed liberal system, a million of manufacturers might be employed in France, to supply England with *silk goods,* a manufacture in which France is eminently successful; and in England, another million of manufacturers might be employed in fabricating *cotton goods* for the French market. The exchange of commodities might go on advantageously to both during peace; but a war unexpectedly takes place, and a million of people, in each of these countries, are deprived of their usual means of subsistence. The consequences would be, such scenes of misery, as cannot be contemplated without horror.

20. That though prosperous manufactures may benefit agriculture, yet if foreign corn be admitted, the advantages are reaped, not by domestic, but foreign agriculturists. Nor can it be too seriously inculcated, that a manufacture, the materials of which are imported from *foreign countries,*—where the workmen are fed on *foreign produce*—and which depends for sale on *foreign markets,* (which must always be precarious), instead of being a blessing, must be a curse to a country.

21. That it is proved by the history of nations, that commerce and manufactures are uncertain and evanescent sources of power; that they tend to enervate those who depend upon them, and that there are

* See Representation of the Privy-Council, 10th March 1790. Annals of Agriculture, vol. iii. p. 419.

other objects to be attended to, as the manly vigour, and moral habits of a nation, of much higher importance than the mere acquisition of wealth.

22. That the present unsettled state of the corn laws, is highly unfavourable to the interests of agriculture: That it prevents those exertions for improvement that would otherwise take place; nor is it possible, during that state of uncertainty, to form any just idea, what ought to be the rent of a farm, or the value of an estate.

23. That if we wish to continue a great and flourishing country, our object ought to be, to lay the foundation of national prosperity, on the basis of domestic, and not of foreign agriculture, and with that view, that it is incumbent upon us to take care, that the prices of agricultural produce shall be such, *as to encourage production*, and shall not have the effect of driving inferior soils out of cultivation. That if such an unfortunate event were to take place, thousands of industrious individuals, who depend for subsistence on the culture and produce of such lands, would be reduced to misery;—extensive tracts of country would be rendered waste;—and all hopes of any farther improvement of our national territory must be abandoned.

24. That even those British Statesmen, who were the least favourable to the agricultural interests, admitted the danger of depending on foreign supplies for food.

That the late Lord Liverpool, in a speech on the 15th March 1815, admitted, that a nation of 10, 15, or 20 millions of people, could not depend on foreign nations for the necessaries of life, *without the most palpable impolicy, and the greatest danger:* And that Mr Huskisson, in a speech, on 27th of February 1815, expressed his apprehension of the hazard of such dependence. " If foreigners, (he said), withheld " their corn from us, it might only affect *their revenue;* but the want " of corn, might inflict on this country *the mischiefs of revolution, and* " *might occasion the subversion of the state.*"

25. That those who must procure food from other nations, must ever be dependent on those who sell it: That the celebrated commercial cities of Tyre and Sidon, (the London and the Liverpool of ancient times), who depended upon Judea for grain, had rashly ventured to quarrel with Herod the King, but finding their error, that they were compelled to bribe the King's ministers to obtain a supply. " They made, (we are told), Blastus the King's Chamberlain their " friend, and desired peace, *because their country was nourished by* " *the King's country* *:" That such is the state, to which the degenerate sons of commerce, would wish to reduce this mighty empire.

26. That the northern countries of Europe, are not to be depended upon for a constant supply of grain: That, in Dr Aikin's Annals of George III. (2d edition, vol. i. p. 358,) we are told, " That in the " year 1785, destructive inundations occurred in several parts of Europe, particularly in Germany, where vast losses were sustained. " This calamity, joined to the inclemency of the seasons, occasioned " a scarcity, *approaching to a famine*, in the north of Europe." What

* Acts, ch. xii. v. 20.

then would have been our state, had we depended, at that time, upon those countries for bread?

27. That the Roman history furnishes ample proof, of the danger of depending, even on a distant part of the same empire for food: That when Vespasian aspired to the throne, he hastened to Alexandria, with a view to distress Rome by famine, since from Egypt chiefly, the city was supplied with corn. But when he was proclaimed Emperor, instead of distressing the city with famine, he dispatched thither, a great number of vessels laden with corn, which arrived very seasonably, for Tacitus informs us, "that fifteen days' subsistence was the most that "Rome had then in store. The winter providentially was mild, and "favourable to navigation; distress and misery must otherwise have "been the consequence. In former times the case was very different. "Italy was the granary that supplied foreign markets. Even at this "hour, the prolific vigour of the soil is not worn out; but to depend "on Egypt and Africa *is the prevailing system.* The lives of the "people are by choice committed to the caprice of winds and waves *."

28. That any individual who peruses the above extract from the first of ancient historians, and who wishes to render Great Britain dependent *on the caprice of the winds and the waves, for the food of its inhabitants*, must have little of the feelings of a British patriot, and is unworthy of that name: That for Rome, read London, for Egypt and Africa, read Poland and Prussia; and what Tacitus wrote eighteen hundred years ago, is exactly applicable to our state at present.

How the million and a half of inhabitants in London, and its neighbourhood, and the thousands who reside in Liverpool, Manchester, and the other towns and villages in Lancashire, are not alarmed with the idea, of depending for their food, *on the caprice of the winds and the waves*, and more especially on importations from so boisterous a sea as the Baltic, (which is likewise shut up from navigation by ice during the winter season), is perfectly unaccountable.

29. That, on the following grounds, a dependence on foreign supplies, is in the highest degree dangerous to any country, whether it is weak or powerful.

1. The country on which we principally depend for food may have a deficient harvest.

2. There may be difficulties in carrying on an intercourse, more especially in the winter season.

3. Foreign powers may impose heavy taxes on the grain they suffer to be exported, both for the sake of revenue, and to prevent high prices at home.

4. There may be a war between Great Britain and that country, or with other nations, by whom our navigation may be interrupted.

5. The countries whence supplies must be obtained, may be afflicted with contagious disorders: And

6. Foreign nations may refuse to take any other mode of payment, for the grain we must purchase from them, *than specie*, any great ex-

* The Annals of Tacitus, vol. i. p. 386, book 12, chap. 43.

portation of which, if a metallic currency is persevered in, would cramp our circulation,—injure all our branches of industry,—and materially diminish our revenue:

IV. *On the System of protecting averages, as indispensable for the Safety of the British Farmer.*

The only rule by which agriculture can be adequately protected is this, "That foreign grain shall not, at any time, or under any "circumstances, be admitted for sale, into any part of his Majesty's "European dominions, until the price rises beyond what the Le-"gislature shall deem to be a reasonable standard of remuneration to "the British farmer." Without such protection, no country, *burdened with a load of taxes*, can stand a competition with poor nations, nearly *untaxed*, who live scantily on homely fare, whose rents are paid in produce, and whose cattle or horses employed in labour, cost but a trifle, and are cheaply maintained. The plan of *exclusion* therefore, until symptoms of scarcity appear, *is essential;* and no encouragement ought to be given, to the culture of foreign countries, with British capital, *unless from necessity.*

Objections have been made to the average system, which are entirely founded on defects in the law, and which can easily be remedied. No corn return ought to be admissible, unless of *real sales* between the growers of corn, and their accredited agents, on the one part, and licensed dealers on the other. All false returns ought to be severely punished; and the privilege of sending returns, ought to be restricted to the twelve greatest markets in the united kingdom. Under these regulations, the fluctuations so much complained of, would be effectually prevented.

It is a most unfortunate circumstance, that any individual, friendly to agriculture, should be inclined to give up the protection by averages, "*which is the only one that can be safely relied on.*" Importation on a fixed duty, without reference to the average price of home produce, may suit the speculative merchant, but would ruin agriculture. The farmer must be enabled to form some general idea, of the price he is likely to receive for the grain he raises, otherwise he cannot calculate, what rent he ought to agree to pay,—what quantity of land to cultivate *for grain,*—what number of labourers to hire,—and whether it would be advisable for him to engage in expensive improvements. *How is it possible that any calculation of the probable prices of grain can be formed, if the whole world is opened to the efforts of speculation?* Dependence on a fixed duty therefore, unless at a rate higher than ever could be enforced, would discourage the British farmer, whom it affects to protect; would expose him to that uncertainty which he most deprecates; and is far from securing to him the command of the home market, to which he has so just a claim, for it is impossible to know, how cheap corn may be grown in other countries, or what may be the rashness of speculators, in importing quantities of foreign corn, which they may be compelled to sell, even with a loss. The dealers in foreign corn say, "that abroad, the price of wheat is so high, "that a duty of 12s. per quarter would be sufficient." But even 20s. on what may be bought at Odessa for 14s. or 15s., and in Sicily also for 19s. per quarter, would be no adequate protection, because the merchant not only buys the corn cheap, but may receive, 1. Advantages from the state of the exchange; and, 2. Mercantile profits on the goods sent abroad, in return for the grain imported. He may therefore lose by the grain he imports to the ruin of the British farmer, (for the effects of a small addition to a quantity already sufficient are well known), but he may gain by the whole speculation, *when he exports goods, as well as imports grain.* No attainable protecting duty therefore, can be effectual. Besides, if foreign grain were to be at all admissible, the rate of admission is of little consequence; for the proprietors in poor countries, as Poland and Russia, who receive their rents in kind, *must sell it* at any price it will fetch.

But the most material objection to a fixed duty is this, that when most wanted, it would not be enforced. If the price became very high, no government would venture to exact a tax upon corn. The payment of the duty would be suspended, though the entire ruin of the farmer would result from it *.

V. *On the Necessity of energetic Exertions for the Protection of Agriculture.*

There never was a country, placed in a more critical situation, than the united kingdoms of Great Britain and Ireland, are at the present moment.

Those principles, by an adherence to which, the British empire rose to a height of prosperity and power altogether unprecedented in history, are in a great measure lost sight of; and new maxims are promulgated, which, if adopted, must inevitably terminate in its destruction.

The national prosperity was founded, on the cultivation and improvement of an extensive territory, containing in all about seventy-three millions of acres, producing all the necessaries, most of the more essential requisites, and many of the luxuries of life, while it furnished at the same time occupation and subsistence, to some millions of a most valuable description of persons, who directed their attention to the improvement of the soil, and spent their lives in carrying on its cultivation.

In 1831-2, a calculation was made by a laborious and intelligent author, (William Marshall, Esq.), who has devoted himself to statistical investigations, and who possesses peculiar advantages for making such inquiries, from which it appears, that the inhabitants of Great Britain

* It has been well observed, that a fixed duty upon the importation of foreign corn, would be a mere delusion upon the British corn grower. The present system is founded upon the principle, of affording to the farmer, a compensation during years of abundance, for the loss which, in seasons of scarcity, he is doomed to sustain, by the laws of nature and humanity. The project of superseding this system, by imposing a fixed duty, is a mere device, to deprive the British corn grower of this equitable compensation, without giving him any adequate equivalent. It would fail him in his utmost need, and place him in a most invidious position, in relation to the rest of his fellow subjects. Indeed the Government has been compelled, in times of scarcity, to grant a *bounty on importation.* How then can A DUTY be enacted?

may be divided, by the occupations they respectively pursued, into the following classes:

Analysis of the Occupations in the Population of Great Britain of 1831-2.

	Families.	Families.	Persons.
1. Agricultural occupiers, ...	250,000	1,050,000	6,300,000
2. Labourers in husbandry, ...	800,000		
(Average of each family 6).			
3. Mining labourers, (average 5)...........................		120,000	600,000
4. Millers, bakers, butchers, (average 5), ...		200,000	1,000,000
5. Artificers, builders, (average 5), ...		130,000	650,000
6. Manufacturers, (average 6), ...		400,000	2,400,000
7. Handicraftsmen, tailors, and shoemakers, (average 6),		180,000	1,080,000
8. Merchants and dealers, (average 6), ...		350,000	2,100,000
9. Seamen, (average 3), ...		250,000	750,000
10. Professional services, legal, medical and clerical,.... (average 5),		90,000	450,000
11. Disabled paupers, (individuals),.........................		1,100 000	1,100,000
12. Annuitants and proprietors, (average 4), ...		500,000	2,000,000
Total, Great Britain,............		4,370,000	18,430,000
Total, Ireland,................................			7,600,000
Total, United Kingdom, ...			26,030,000

In such calculations, regarding matters subject to perpetual fluctuations, minute accuracy is not to be expected. All that can be looked for is *an approximation to truth.* It is evident however, that the manufacturing classes, when compared to the agricultural, form but a small portion of the community; yet, in consequence of their living contiguous to each other, their being easily assembled, having active and interested leaders to manage their concerns, and being disposed to act in unison, they have acquired a degree of importance in the state, to which they have no just pretensions.

But the persons who are at the bottom of this mischievous cry for a change in our corn laws, who demand cheap corn, and who deceive the public by the most artful misrepresentations of the advantages to be derived from foreign importation, are, "*the dealers in foreign corn,*" and in particular those who are employed to sell that article *on commission.* It is they who insist on the repeal of all laws favourable to domestic growth, and demand, that full liberty shall be given, for the importation of grain, without any restraint whatever, and from every country in the universe.

Such doctrines cannot be too loudly reprobated.

The territory belonging to a nation is its "*capital stock,*" on which it necessarily depends for its prosperity and subsistence; and "*the* "*agricultural classes,*" and those depending upon them, are, properly speaking, "*The nation,*" being the only individuals in it, *who have a permanent interest in its prosperity.* The importance of these classes is not sufficiently known or appreciated; but it evidently appears, from the table above inserted, that when collected, they are greatly superior, in regard both to the number, and the value of their productions, to those less essential classes, who presume to despise them. A nation cannot subsist without the productions of the soil, but it can abundantly prosper, without those manufactures, to the existence of which, theoretical writers absurdly attribute so much importance. The people of this country were happy and powerful before the cotton trade was introduced among them ; and if the cotton weavers cannot exist, without the importation of foreign grain, why should the agricultural classes in Great Britain and Ireland be reduced to beggary on their account ? Why should, not only millions of acres be condemned to perpetual barrenness, but immense tracts already improved, be laid waste, to gratify their wishes ? In the reign of William the Conqueror, an extensive tract was rendered desolate, that he might enjoy the pleasures of the chase. No circumstance mentioned in the English history is so loudly reprobated. Yet it is now proposed, to lay waste millions of acres, and to reduce to poverty thousands of the most valuable subjects of the empire, under the pretence, that a number of weavers in cotton, cannot otherwise be supplied with cheap food.

If the measure of protecting averages be objected to, the following plan, which seems to me not liable to any material objection, may be adopted.

Let some public institution, (like the Board of Trade), be authorised, as soon as the harvest is completed, to make every possible inquiry into the state of the crops.

If the board has ascertained, that there is likely to be a deficiency, let it then advertise the amount required to be imported, and its desire to receive offers, for granting licenses to furnish grain to that extent, either by those who have corn already warehoused, or those who will undertake to bring, from foreign parts, the quantity required. Those who offer the highest duties to be preferred, by which any risk of partiality will be prevented. Where the offers are the same, proportionate deductions to be made from each.

This plan would be attended with the following important advantages :

1. A larger quantity would not be imported, than would be required for the supply of the country, though it would be advisable, rather to exceed, than to be under the mark.

2. The demand being kept within fixed bounds, the importing merchants would not be induced, to raise the price abroad, to that immoderate amount, which must be the necessary consequence of unlimited speculation. Their profits occasionally might not be so great, but, on the other hand, they would run no risk of loss.

3. The duty on the grain to be consumed, would be insured to the Exchequer, before the corn could be brought into the British markets ; and,

4. The agriculture of the country would thus receive a certain, and consequently a most essential protection ; and there would be no risk, by exciting a rage for speculation, that grain of inferior quality, unfit for human sustenance, would be introduced into our markets.

There never was any plan of a corn law, that seems to unite so many important advantages.

It is now generally believed, that as soon as the new Parliament assembles, a great exertion will be made, on the part of the manufacturing interest, to get the corn laws altogether abolished, and to put an end, even to that scanty protection which the landed and farming interests now enjoy. There never was such infatuation; for it can be proved, that these ungrateful manufacturers, chiefly depend, for the sale of their goods, *on the home market;* and that it is from the purchase of their fabrics, *by British subjects*, that their prosperity chiefly arises. It is, in a very inferior degree indeed, that they are benefited by foreign demand.

In order however, to prevent the ruinous consequences that would necessarily result, from the unlimited admission of foreign grain, the following resolutions, are submitted to the consideration of those, who are anxious to maintain an opposite system.

Resolved,—

1. That it is in the highest degree unjust, and even absurd to expect, *that the rents and profits derived from British agriculture*, shall be expended in the purchase of goods produced from foreign materials, while the manufacturers of those goods, resolve to encourage the consumption of foreign agricultural produce, and insist on the repeal of those laws, which have been enacted for the protection of domestic agriculture.

2. That those manufacturers, on inquiry, must be convinced, that the home market is their best resource: That the destruction of British agriculture, would be ruinous to themselves; and that a dependence on foreigners for their food, is the most hazardous of all speculations.

3. That all shopkeepers, and dealers in manufactured goods, be informed, that it is incumbent upon them, to point out to the manufacturers with whom they deal, the ruinous effects, that would necessarily result, from the conduct they propose to adopt: That if these manufacturers are successful in their attempts to destroy British agriculture, it would terminate in their own ruin; and that the manufacturers of Great Britain, are never in so prosperous a state, as when its agriculture flourishes.

4. That if any attempt is made, in the approaching Parliament, to destroy, or even to diminish, the protection which the agricultural interests of Great Britain and Ireland now enjoy, the agricultural classes of the empire must unite, in counteracting it; and that petitions ought to be presented to Parliament, from every parish in the united kingdom, against any attempt to destroy, or materially to impair that protection, which British agriculture ought to enjoy: And,

5. For the purpose of preventing the purchasing of goods, manufactured by those who apply to Parliament, for enacting measures so ruinous to the general interests of the empire, that those shopkeepers, who promote so destructive a system, shall no longer be dealt with by any friend to agriculture.

CONCLUSION.

On the Danger of depending for Food on Foreign Importation.

There is no thinking individual, who must not be shocked at the idea, of a great country depending on foreign nations for food, when by any exertions, and at any expense, it can raise that food at home.

The only pretence for placing a nation in that hazardous situation is, that the grain may be had cheaper. That may occasionally be the case; but dearly would that advantage be obtained, if a country is entirely put in the power of foreign nations, and of domestic dealers in, and importers of corn.

When once it is ascertained, that we must depend on foreign nations for food, the price abroad necessarily rises. Indeed, that very circumstance, is one of the arguments used in favour of importation, and our making purchases abroad. It is said, that foreign manufacturers can undersell us, because they have cheaper food; but it is contended, that if the price of food is raised by our purchasing their grain, they will be less able to contend with our manufacturers, and the rivalship would be carried on more on a footing of equality. What then becomes of the arguments, in favour of the expectation of procuring cheap food, from foreign countries, when it is maintained, that, in the result, corn will become as dear abroad, as at home?

In case of war, it is evident, that there can be no certainty of our obtaining the necessary supplies, and above all, at the places where a supply is wanted. How could London be regularly fed, more especially in time of war, and since the invention of steam navigation, if it depended upon the Baltic for its provisions, and if the ports of Belgium were in the possession of a hostile power? In time of war also, the grain we should import, would be loaded with the burdens of additional freight and insurance. Could London then be supplied as cheaply from foreign parts, as from Kent, Norfolk or Suffolk?

In short, there are such multiplied risks, connected with the proposed plan of depending on importation, and so many powerful objections can be urged against it, that none but persons having a direct interest in its establishment, would ever think of urging it; and a nation which should suffer so dangerous a system to be pursued, would well deserve, all the calamities that must necessarily result from its adoption.

Domestic agriculture therefore, ought to be protected, as the real source of public as well as private prosperity; and the only sure foundation of all those blessings which, under the guidance of a gracious power, can either enrich or ennoble a country.

133. George Street,
Edinburgh,
1st October 1832.

JOHN SINCLAIR,
In the 79th year
of his age.

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EXPLANATIONS OF THE PLATES.

PLATE I.

Plan of Farms and Farm-Buildings.

This plate is intended to give an idea of the most advantageous arrangement of a Farm, and its buildings, hitherto suggested, and the most eligible rotations of crops, whether in a strong or in a turnip soil.

No. 1. Is the plan of a strong loamy, or clay land farm, of 300 acres, divided into six fields, of 50 acres each, under the most productive rotation for such soils, namely, 1. Fallow, or fallow crops; 2. Wheat or Barley; 3. Clover; 4. Oats; 5. Beans; 6. Wheat.

No. 2. Is the plan of a turnip-land farm, of 400 acres, divided into eight fields of 40 acres each, and four fields of 20 acres, under a rotation of four crops, 1. Turnips, or other green crops; 2. Wheat or Barley; 3. Clover; and, 4. Oats: but it is in general advisable, to have one or two years' pasture, after the clover, to insure an abundant crop of oats; hence this is likewise a rotation of six crops.

The house and offices are supposed to be situated in the centre of the farm, the advantages of which are very great. The farm-house to be placed either in the front of, or behind the garden, according to circumstances. The corners to be all rounded, to prevent accidents to carts. The thrashing-barn and mill, with its horse course, to be adjoining to the corn-yard. The yard to be so intersected by roads, that every stack may be accessible at any time, to be easily conveyed to the barn. The ponds and well, to be conveniently situated. The houses and gardens for the farm-servants, to be at a moderate distance from the house. The corners of the fields only to be planted, and the hedges to be kept low, for the admission of air, and to prevent vermin. An industrious farmer, could well afford to pay from one-fourth to one-third more rent, for a farming establishment constructed on these principles, than for one arranged in the confused and inconvenient manner in which farms are usually laid out.

PLATE II.

Description of the Improved Swin-lough, the Grubber, and Mill for making o-Barley.

No. 1. This represents the left hand, or land-side of the improved swing-plough, when completed. A B, the beam; B C, the left hand stilt, or larger handle; D E, the coulter; D F G, the sock or share; I K G H, are cast-iron plates, nailed on the land-side of the plough, to prevent the wood from wearing; K H, the back-end of the mould-board; S, the sheath;

M N, the muzzle or bridle, placed upon a bolt that passes through a hole in its arms, and fore-end of the beam at A, on which bolt it has liberty to turn, to give the plough a greater or less hold of the ground. N O, a cross, fixed on the back part of the bridle, having different holes, to receive a bolt that passes through any of them, and a hole in the beam; by this bolt the bridle is kept steady, when placed in the proper position, for causing the plough to penetrate to the intended depth in the ground. P R, the swing or cross trees, and chain of draught, attached at M to the beam.

No. 2. This is a plan, or bird's-eye view of the same plough. A B, represent the beam; B C, the larger handle; and D, the lesser handle fastened to the larger one by the rods L M, which hold them at a proper distance from one another. G D, the lower edge, and I H, the upper edge of the mould-board; F G, the sock and feather; N B, the bridle, placed upon a bolt which passes through a hole in its arms, and the fore part of the beam at O, by which it is attached to the beam; R S, the larger cross or swing-tree, fixed by a chain to the fore-part of the bridle N, having several holes, into any one of which the draught may be fixed, according as the furrow-slice is required broad or narrow. T U V, the lesser swing-trees, attached at R S, by iron chains, to the larger one, and to them, the cattle are yoked when ploughing.

No. 3. Shews the angle at which the furrow-slice is placed, when this sort of plough is made use of.

No. 4. Plan, or bird's eye view of a grubber, with eleven shares. A B C D, represent a strong wooden frame, into which the arms of the shares, or claws are inserted, and secured on its upper side by screw nuts, so that they may easily be taken out when requiring repair, and to increase or diminish their number at any time, if found necessary. E G, represent five, and H six, of the shares placed so as to move at equal distances from each other: by which they cut up the weeds in their progress, and loosen the soil a few inches deep. I K, and L M, the shafts, or timbers, by which the machine is drawn. N O, and P R, are two wheels, that revolve upon the iron arms 2 and 3, which arms are fixed by screw-bolts on the wooden axle, at the ends K and M. The regulating beam U V, is fastened upon this frame, at Q and V, with screw-bolts, and attached to the axle at U, by an iron bridle. K W, and M Y, are two chains, fastened to the shafts at K and M, their other ends passing through holes in the side rail of the frame at W and Y, in which they are secured by screw-nuts. These chains yield, and allow the shares to rise up or down, according to the inequality of the land. S and T, are two cylinders, the pivots of which turn in the lower part of iron arms, which can easily be shifted either up or down, in order to regulate the depth to which the shares are intended to penetrate in the soil.

No. 5. Profile of the same instrument. A B, represent a wooden frame, into which the iron arms, C D, are inserted, and secured above by screw-nuts; upon the lower end of these arms are welded the shares E and F, which penetrate the land to a small depth, and cut up the weeds as they pass along. G L, represent the shafts or limbers, fastened on the axle by iron bolts. H, is a piece of wood fixed upon the wooden axle; and into this piece of wood, are fastened iron bolts, having eyes to take in the iron rod P K; which rod passes through a hole in the beam O B, at H. By this means, the beam has freedom to move up or down on the rod, and can be fixed to any part of it, in order to make the foremost shares go either deeper or shallower in the ground. M S, represent one of the wheels, which revolve on the axle, that carries the hindermost end of the shafts. N, represents one of the cylinders, the pivots of which turn in the iron arms T. These cylinders hold the back end of the wooden frame A B, at an equal distance from the surface of the land, and of course regulate the depth to which the shares are to penetrate the soil. B P, one of the handles by which the machine is directed, when at work.

No. 6. Section of an improved machine for making pot or pearl barley. A B C D, represent a strong wooden frame, which carries the machinery; E F, an axle, upon which is fixed the tooth wheel, No. 1, which may be turned by any machine having sufficient power; or a water-wheel may be placed on the same axle, for that purpose. No. 2. represents another wheel, fastened upon the axle E F, to drive the wheel No. 3, which is placed on the iron spindle O P; and upon this axle the mill-stone is also fixed. (See I K, in Fig. 3.) G H, represent the curb or case, that incloses the mill-stone and barley, when making. No. 4. a wheel fixed upon the case G H, turned by a wheel and a pinion. R S, are bearers, in which the case G H, revolves when the machine is at work. K, a hopper, to contain the rough barley. M, a spout, or pipe which conveys the barley into the case at P: in the circumference of the case G H, is an opening, having a valve, or shutter, which allows the barley to issue out into the spout H N, that conveys it down to the trough, or mill floor.

No. 7. Profile of the same machine. O P R S, represent a perpendicular frame, in which the wheel and mill-stone revolve. No. 1. represents a toothed wheel, fixed upon the axle R, and may be attached, or turned, by any machine driven by water, by wind, or by cattle. No. 2. a wheel, also fastened upon the axle R, having teeth in the circumference to turn the wheel No. 3, which is fixed on the iron spindle, or axle, that carries the mill-stone; and the case T U, which incloses the stone, and contains the barley. The circumference, and both sides of the case T U, are covered with sheet, or plate iron, in which are small holes, that allow the dust, or small refuse to pass through; at the same time retaining the barley, till sufficiently clear of the husk. The frame of this case is made to separate in the middle at T U, and is fixed together by screw-bolts, so that it can easily be placed on the mill-stone, or taken off at any time if necessary.

The machine above described, performs the operation in a safe and proper manner, without either breaking or cutting the grain. The advantages of this process are very great. Pot-barley is a most wholesome food, and is well entitled to the name of "*European rice.*" It may be consumed in the same manner as rice, either boiled with milk, or ground into meal, and made into puddings. It makes excellent cakes, and mixed with wheat, in a proportion of one-third, or one-fourth, it makes bread of a quality scarcely to be distinguished from bread made entirely of wheat. It is supposed, that the flour of barley is the wholesomest of any. It makes the purest blood, and is particularly calculated for bilious people. The refuse is an excellent food for horses.

PLATE III.

Description of the Corn-Stacks, with Cast-iron Pillars.

In the stack-yard at Shaw-park, in Clackmannanshire, there are 28 stacks placed on cast-metal pillars, three feet high. Each of these stacks contains 1584 sheaves, which, in all, would produce 728 Scotch bolls, or 539 English quarters of barley or oats; but that number of stacks, might contain a greater quantity of grain, if necessary.

The weight of each pillar should not exceed one half cwt., which, at 16s. 4d. per cwt., is 8s. 2d. for each pillar; but they can be made lighter, and may easily be afforded at 7s. per pillar: hence,

Seven pillars, at 7s. each, ...	L.2	9	0
Wood and workmanship, about	2	11	0
Total expense,	L.5	0	0

In the first year, by an accurate experiment, comparing the same quantity of wheat, built on the ground, or on cast-iron pillars, the saving was L.2 : 12 : 6 per stack, and the whole expense would be repaid the second year.

If the pillars were higher, say 3½ or 4 feet high, the grain might be harvested sooner; but at the present height, wheat has been stacked in five days, beans in eight, and barley and oats in ten days, and sometimes earlier. No vermin can find their way into these stacks to consume the grain, and the straw is better preserved. The *boss*, or triangle, keeps up a circulation of air, and prevents heating, or other damage.—See General Report of Scotland, vol. iv. Appendix, p. 379.

In regard to the boss or triangle, a few spars of fir, or any other common wood, ought to be nailed across it, to prevent the sheaves from falling in; but if these cannot be got, a straw rope will answer the purpose.

PLATE IV.

Description of the Culture of Drilled Turnips in Scotland.

The advantages to be derived from drilling turnips, as practised in Scotland, and in the northern counties of England, have been already explained, (see p. 371). But as this is perhaps the most complete operation that agriculture boasts of, it may be proper to give a more particular description of it, accompanied by an engraving, from an inspection of which, it will be more clearly understood *.

Fig. 1. Is a section of the drills, as first formed, and having the muck or dung spread out in the hollow drills, with a line, pointing out where the ridglets are afterwards split.

Fig. 2. Represents these drills, as split open, to cover the muck; what was formerly the hollow drills, is converted, by this operation, into the ridglets, and *vice versa.*

Fig. 3. Gives an idea of the figure of the drills or ridglets, after having been rolled by the drill-machine, at the time of sowing the seed. The seed cannot be sown too soon after the land is thus prepared for its reception.

Fig. 4. Is a representation of the appearance of the field, after the earth has been gathered into the intervals between the turnip drills, as formerly practised, but which has now given way to the use of the horse-hoe.

Fig. 5. Shews the situation of the drills, on finishing off the field, according to the old system, by splitting open the gathered ridglets in Fig. 4, but which practice is not now generally followed.

Fig. 6. Gives an idea of the situation of a field of drilled turnips, as now generally finished off; the furrows, or hollow drills, not being opened out, the shave, or tops of the plants, being removed for the use of the young stock, previously to the feeding flock being laid on.

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* In the year 1797, Mr Alexander Low, an eminent land-surveyor, drew up, with great clearness and ability, a short account of the Berwickshire mode of turnip culture, for the late Duke of Bedford, which was the first complete description given of this superior practice.

Fig. 7. Gives a plan upon a smaller scale than the preceding sections, of a turnip field in regular drills, in which the drills are laid off obliquely to the usual direction of the ridges, to facilitate the more equal distribution of the dung, which had been covered up in the drills, when afterwards ploughed for a crop of grain.

PLATE V.

Description of the Barrow for sowing Grain in Drills.

Fig. 1. Plan, or bird's-eye view of a drill-barrow.
2. Profile of the same implement.
3. End view of the same.
4. No. 1. An edge view of the seed-wheel. No. 2. Profile of the same wheel with flutes, or channels to receive the beans, and also a brush made of stiff bristles, placed above the wheel, to cause the seed to drop regularly into the bottom of the furrow.
5. No. 1. and 2. Seed wheel for sowing oats, barley, wheat, and pease. Either of these wheels may be easily placed upon the axle, or taken off at pleasure, according to the sort of grain to be sown.

Description of the Drill-Harrow.

Fig. 6. Plan of a harrow for cutting weeds and pulverising the soil betwixt the drills.
7. Profile of the same machine.
8. No. 1. and 2. Plan and profile of the front share.
9. No. 1. and 2. Plan and profile of one of the hindmost shares, which shares may be easily shifted and fixed at a greater or less distance from each other, according to the distance between the drills, which is shown by the figure.

PLATE VI.

Plan of an Apparatus for steaming the Food of Cattle, belonging to and invented by Mr George Bogrie, Farmer, Monkton, arish of Inveresk.

A. Steam cylinder, in which the potatoes or turnips are steamed, Fig. 1, 2.

B. The cover, half of which is taken off when required to be filled, Fig. 1, 2.

C. An iron bar for lifting the cylinder, by means of the pulleys D, Fig. 2, the running rope of which is attached to the crane B, Fig. 3.

F. The boiler, built in with flues in the ordinary manner. It is in two halves, screwed together, Fig. 1, 2, 3.

G. A floating ball for opening and shutting the conic valve H, to regulate the quantity of water, Fig. 1, 2, 3.

J. The water cistern for feeding the boiler, supplied from the pump K, Fig. 1, 2, 3.

LL. The steam pipe, commencing near the top of the boiler, passin through the side, and through the building, under the false bottom of the cylinder, Fig. 1.

M. The false bottom of the cylinder, perforated with holes for a passage to the steam, Fig. 1.

N. A cock for letting off the condensed water, when it collects under the false bottom, Fig. 1, 2, 3.

O. A cock for drawing the water from the boiler, Fig. 1, 2, 3.

P. The furnace, Fig. 2, 3.

Q. The cooler into which the potatoes fall when steamed, the cylinder being drawn up from off the grooves R R, surrounding the false bottom, Fig. 1, 2, 3. The condensed water in the groove prevents the escape of steam.

DIRECTIONS TO THE BINDER,

FOR PLACING THE PLATES.

☞ *Note.*—Folios referred to in the Work.

APPENDIX.

MEMORANDUM.

It would be of use to the diligent farmer, anxious to acquire a thorough knowledge of his profession, to have a copy of the Code of Agriculture interleaved, and to write on the blank leaves, not only such remarks as may occur on the perusal, but also any additional information which he may acquire on each subject, from other works on husbandry,—or from persons engaged in agricultural pursuits,—or from his own experience.

EDINBURGH:
PRINTED BY JAMES WALKER.

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