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SUBSOIL PLOUGH.

MADE BY THOMAS ROBERTS, WARWICK.

A TREATISE
ON
Practical and Chemical
AGRICULTURE,
COMPILED, PRINCIPALLY,
FROM THE SCIENTIFIC WORKS OF SIR H. DAVY, WHEN
CONCURRING WITH THE EXPERIENCE DERIVED
FROM A LONG AND EXTENSIVE PRACTICE;
WITH
A Dissertation
ON THE
CULTIVATION OF THE SOIL,
Upon an Improved and more Profitable System;
AND
THE WAY TO ASCERTAIN THE VALUE OF LAND,
TITHES, AND PARISH ASSESSMENTS.

TO THESE ARE ADDED,
AN ESSAY ON RED CLOVER;

Likewise,
SOME USEFUL OBSERVATIONS ON SELECTING, BREEDING,
REARING AND FEEDING OF STOCK;
AND OTHER INTERESTING MATTERS CONNECTED WITH
BRITISH AGRICULTURE,

BY JOSEPH RUSSELL,
Author of 'A New System of Agriculture,' and 'Observations
on the Growth of British Corn.'

~~~~~  
THE SECOND EDITION.  
~~~~~

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TO THE
RIGHT HON. LORD LEIGH,
THE
LIBERAL PATRON AND ZEALOUS PROMOTER
OF
British Agriculture,
THIS WORK,
IS
MOST RESPECTFULLY INSCRIBED,
BY HIS HIGHLY GRATEFUL,
AND VERY HUMBLE SERVANT,
THE AUTHOR.

PREFACE

TO THE SECOND EDITION.

WHEN this Work was first published, ten years ago, it had to contend with the most formidable obstacles, in a system of fallowing, adopted by one generation after another, for a long succession of ages—even when other improvements, and those very important, were gradually advancing; the abolishing of summer fallows, seemed to claim very little, if any, attention from the cultivators of the soil: and but few thought of, and less were inclined to follow, any method pointed out to them, that was likely to interfere with their old custom.

Some farmers, however, who had less prejudice, or more judgment than their neighbours, adopted the system I have advocated, by raising Corn and Cattle

crops, alternately : by which means, they have been able to clean their land more effectually, and likewise to keep more stock.

The First Edition of this Work, was soon disposed of, and it has now been long out of print. I have been much flattered by the encouragements of those farmers who have carried my system into practice ; and I am also highly gratified to hear from those persons who have adopted the plan of breeding, which I recommended, that their stock has been considerably improved.

In revising this Edition, I have corrected many inaccuracies, and made other alterations in the text, which the work seemed to require ; and I hope the present volume, will be found still more worthy of the support and patronage of that class of persons for whom it is more particularly designed.

Kenilworth, October, 1840.

P R E F A C E

TO THE FIRST EDITION.

IN laying the following Work before the Public, I acknowledge, candidly, that I could not entirely divest myself of a certain portion of active ambition—ardent enough, I hope, to stimulate my exertions, but quite incapable either of making me vain or presumptuous.

During a long, and I believe, I may at the same time say, a very active life, passed wholly in Agricultural and Chemical Pursuits, I have, I conceive, had many opportunities of making observations, and of collecting information connected with that important subject, which but few other persons have possessed. I have for some time been anxious to arrange in something like methodical order, those observations; and, accompanied with my own reflections upon the various facts to which they refer, to lay before my Agricultural Friends, the result.

In doing this, and I have aimed at nothing more, I have endeavoured to convey my sentiments in language at once plain and intelligible—to state circum-

stances as they occurred—and to comment unreservedly upon those notices, not wholly fearless of offence—yet, most certainly, hoping not to offend.

The reader, I well know, will not expect to find in this Work, any refinement in language, or any display of eloquence; for, if I possessed either, this, of all others, would be the last subject I should choose whereon to exhibit them—because, although I am writing to many gentlemen of high talent, of profound skill, and of extensive experience, in the profession to which they are an ornament and an honour—I at the same time know, that I am also addressing men of strong minds, who prefer plain common sense to fine words—facts to opinions—and usefulness to decoration.

I have been honoured with patronage of which I am justly proud, been sanctioned by individuals whose liberality I cannot too highly appreciate, and supported by friends, whose attachment I am happy to acknowledge—and this makes me feel, and I feel it most sensibly, that the obligation, as the case at present stands, lies all on one side; and there it will continue to remain, if I do not shew clearly that I have diligently endeavoured, as far as my humble abilities would permit—to merit that patronage, and to deserve those friendships.

One of my chief objects, in composing this Work, has been to show that *Agriculture* and *Chemistry* are at all times intimately connected with each other, and

that the latter is always in active operation, although the cultivator, in general, is not cognizant of its effects. A small portion of chemical knowledge, however, will enable him, in some important points, to recognize those effects, and to refer them in most cases to their proper causes. By attending to the directions which I have laid down for his guidance, he will be competent, without much trouble or expense, to analyze the soil, and from thence be able to determine what particular quality of earth is redundant, or deficient, in that soil. Having proceeded thus far in his experiments, the natural inference is, that he knows what kind of manure he ought to apply to his land with the best prospects of obtaining a crop. This is almost the only chemical knowledge that an agriculturist need to possess, for all the common purposes of cultivating his land; and these experiments, steadily pursued, will soon convince him that his infant *System* is approximating, by degrees, into a *Science*—which is nothing more than when skill, directed by defined and fixed principles, will enable a person to anticipate the result of certain combined operations.

In the IMPROVED SYSTEM, which I have so zealously advocated in the body of this Work, I have recommended nothing that can alarm the most timid agriculturist. No material advance of extra capital—no greater risk of seasons—no speculation. I have, it is true, advised a change in the course of cropping,

and I have little doubt that I shall prove highly to the satisfaction of many—(because it will contribute greatly to their interest)—that a *good green crop* is preferable to a *barren fallow*, and that to keep much more stock on every description of land, than he now does upon the *Old System*, will not only enhance his credit as a farmer, but will also increase his profits.

Knowledge in the Art of Agriculture, where it has to contend with the rank weeds of *Prejudice*, is a scion of but very tardy growth. Improvements in this branch have not only the sturdy obstacles of antiquated customs to overcome, but the seasons, soil, situation, and management, are not unfrequently found amongst their powerful opponents. Yet, notwithstanding this formidable array, I trust the time is not far distant when I shall see those customs, which I have long considered to be a reproach to the enlightened age in which we live, ejected from our fields.

The reader must not omit to bear in mind, that my paramount object is to combine, as far as they can at present be usefully connected in an agricultural point of view, practical experience with chemical knowledge; and to accomplish this desirable end, it was indispensable to the proper elucidation of this subject, that I should extract largely from the scientific works of that eminent writer, Sir Humphrey Davy, and to quote, occasionally, from several other authors; and, it is very possible, considering the many works I have read

upon agricultural subjects, that in the observations I have made, I may have adopted the ideas of others, and blended them with my own, without knowing now with whom they originated. If I have done so, I do assure my readers, that I would not, wittingly, deprive another of his well-earned fame, in any way, for any temporary advantage that I may appear to have derived from such an unworthy action.

The remarks upon Breeding, selecting Stock, &c. &c. do not require from me in this place, I conceive, any particular observations, as they are all so largely treated upon in the body of the work.

Some of the numerous Tables which I have introduced, were calculated at the time when meat was at sixpence a pound. All of them, however, may be varied according to the rise or fall in the price of agricultural produce at any period; and they will at all times furnish the young and inexperienced agriculturist with correct data on which he may proceed with confidence, because he can, agreeably to the variation of circumstances, adapt them to suit his own views, and his own particular purposes.

Many of my old acquaintances, I well know, will take up this volume, to see what, in his journey through life, a Brother-agriculturist has picked up in his way, and on comparing its contents with the store of knowledge which he himself has collected, will cheerfully assign to me that portion of merit,

however humble that may be, to which I am fairly entitled.

But if I can compromise so easily with my own personal friends—what apology, it may be asked, shall I make to the Public, for thus intruding myself upon their notice? That is, in fact, a question not so readily answered. Yet I can to them truly say, that this little Work, has to me, been one of excessive labour, of intense application, and the result of long experience and careful observation; and although, on perusal, they may find in it some errors of minor importance, I hope it does not exhibit any of those constitutional defects, that can at all militate against the main principle on which it is founded.

Finally, I have endeavoured, to the utmost extent of my power, to make myself useful to this as well as to succeeding generations—and if I have done so, I wish for no other reward.

With these remarks, then, I throw myself upon the candour, the liberality, and the generosity of an enlightened Public.

JOSEPH RUSSELL.

Kenilworth, Dec. 30th, 1830.

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THE SUBSOIL PLOUGH.—(*Frontispiece.*)

THE Subsoil Plough was noticed by the author in the first edition of this Work, published in 1831. He had long been convinced of the utility and necessity of constructing an implement that would break up the density of the earth, occasioned by the trampling of horses on the surface, in each process of ploughing, which rendered the subsoil useless for the growth of plants.

Fig. 2—represents the apparatus for lifting the subsoil shares out of the ground at land's end. It is fixed on the plough (Fig. 1) when worked at full depth, and by means of the lever attached to the centre wheels, the man who follows the plough releases the lever, which allows the wheels to fall beneath the subsoil shares, and bear the plough round at land's end; the ploughman at the same time having his hand on the lever, takes up the wheels, and the plough immediately falls into its regular work.

The first subsoil share works directly before the plough, cutting up a part of the earth, which is instantly covered by the plough; the hinder share works by the seam of the plough furrow, cutting up the remainder of the earth; leaving the whole loose and untrampled on by the horses. The shares may be set to work from two to eight inches deep, according to the nature of the subsoil, and the power of the team; but if the shares be required to go deeper than four or five inches, the writer recommends it to be done at two ploughings.

This, at first sight, may appear to some to be a complicated piece of machinery, but when at work, it is very easily managed by the ploughman. On wet or obdurate soils, it will require a man to guide the plough; but where the soil is light, and not stony, the wheels will regulate the width and depth, as in the common wheel-ploughs.

The advantages of subsoil-ploughing are numerous. First, the breaking up of the earth supplies a greater depth of soil for the nourishment and growth of the roots of plants. Secondly, the soil retains more moisture on hot land, and in a dry season protects the crop from scorching. Thirdly, in a wet season the rain readily enters the subsoil, which prevents the crops from being injured by stagnant water. Fourthly, by stirring the subsoil, it becomes permeable to air and moisture; and gradually more fertile.

No. 2.

THIS is a machine for cutting and collecting on pastures, those heads of clover which have been rejected by the stock ; as the seed, by the present expensive process of mowing and gathering it, is generally lost by the grower.

The cylinder C, is four feet and a half in length ; eight knives are fixed to it worked by a spur-wheel. Behind the cylinder is a comb, with teeth similar to those of a heel-rake, for lifting the straggling heads, and bringing the whole into contact with the knives. The knives carry the heads to the centre, when by the velocity of the cylinder they are thrown into the box. In gathering the heads of white clover in pasture fields where they lay near to the ground, the cylinder is set low, and the heel of the comb drags on the ground, while the ends of the teeth, by projecting upwards, slide over the stones ; any sticks, or other rubbish, that may obstruct the working of the machine, should be timely removed.

In stripping the heads off a full crop, it is better to work the cylinder only half the width, say two feet three inches ; which allows the horse to walk on the stubble, and prevents any heads from being trodden down by him or the boy. In going over the ground again the reverse way, the machine is almost sure to pick up any heads that escaped the first time. The machine can be easily worked by a small horse ; and one with a shorter cylinder might be readily worked by hand.

The writer sent a model of this machine through the medium of the late Hon. R. F. GREVILLE, to the Society of Arts and Sciences, when the late Sir JOSEPH BANKS was the President, and received a mark of honour from that Institution. The model was exhibited in the Society's room for many years, and though no mechanic, to his knowledge, has made a Clover-head Gathering-machine upon the same principle, yet it seems to have been so far usefully deposited as to cause improvements in machinery for other purposes. The Lawn and Bowling-green Mowing-machine, now so generally used, is constructed on the same principle, and works in the same manner, with the exception that the cylinder and box are borne up by rollers instead of wheels ; and the comb is also dispensed with when used for this purpose.

CLOVER HEAD GATHERING MACHINE.

A. One of the wheels that carries the box.

B. Chain wheel.

C. Cylinder with the cutter.

D. Cone with a comb under the cylinder.

E. Box to receive the clover heads from the cylinder.

F. Centre wheel to carry front part.

G. Iron carriage for the centre wheel to work in.

H. Upper part of the centre wheel carriage made round so that it may turn freely at lands end.

I. Shaft attached to the carriage. G. H.

A TREATISE
ON
Practical and Chemical
AGRICULTURE,
&c. &c.

CHAP. I.

CONTAINING SOME GENERAL INTRODUCTORY OBSERVATIONS, AND SHEWING OF WHAT GREAT IMPORTANCE THE CULTIVATION OF THE SOIL IS TO MAN.

THE Cultivation and the Produce of the Soil, forms a subject of the deepest interest to every class of persons united by the ties of friendly intercourse, in every community of civilized society. Indeed, it is one of the first, and even the principal object that strikes, and fixes itself permanently on the mind of man, the moment he emerges from a wandering state of savage life; for he no sooner finds that he can depend upon the productions of the earth for a supply of food, more than sufficient to satisfy all his wants, than he fixes himself to one spot, becomes lord

of the soil, and exerts the whole of his newly-acquired knowledge, in raising from his little principality, the means of subsistence for himself and his family ; and, in the course of time, the chase, upon which he had formerly depended for a precarious living, is only resorted to as a matter of amusement.

The Earth was a gift to man, from Heaven ; and, by Divine Command, to “ bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit ;” when Cattle, and all other created beings, by the Divine Blessing, were ordered to be fruitful and multiply, and replenish the earth. The Cultivation of the Soil, therefore, is a sacred, a noble, and an essential pursuit. Essential, because its object is to produce the necessaries of life—noble, because its benefits are as diffusive as the light that ripens its productions—and sacred, because it may, relatively, be considered of Divine Ordination.

It may be asserted, (says a writer upon this subject,) without hesitation, that Agriculture is the support and the ornament of civil society. It distinguishes the man from the savage, the community from the horde, as well as ornamenting the face of the earth. And it has also been said, by a great and learned author, that he who makes two blades of grass grow, where one formerly used to grow, deserved better of his country than a great statesman. Another too, has most happily said, that he who discovered and first cultivated the farinaceous plants, deserved to be ranked amongst the greatest benefactors of mankind.

It is an acknowledged fact, and one which universal experience has established beyond a possibility of doubt, that the soil is capable of supplying the maintenance of a much greater number of persons, than are required for its cultivation; nor is it less obvious or less certain, that there is always an intimate relation between the productive energy of the soil, and the skilfulness of its management; it is, indeed, this surplus produce which yields profit to the Cultivator, rent to the Landlord, support to the Manufacturer, and revenue to the State. To increase it, therefore, is the legitimate end of improvement, and it is presumed that no one, at all acquainted with the subject, will for a moment suppose, much less venture to assert, that this improvement has yet reached its *ULTIMATUM*. Hence the responsibility which Providence has attached to the Proprietors of the soil, a responsibility which is not less imperious in the duty it imposes, than important in the patriotism it involves.

There perhaps has never been a period in the History of the Rural and Political Economy of Britain, in which the duties and qualifications of those who are intrusted with the management of its landed property, have assumed so much consequence as at present; various circumstances have, within the last forty-five years, contributed to the production of this effect. About the commencement of that period, a general commotion agitated the Nations of Europe, and Britain became the Asylum of the destitute, the rock on which they fled for safety; her naval and military establish-

ments even surpassed every former precedent, and the expenditure of human life and labour, in supporting the war, became unparalleled ; the mass of industry, from the useful and ornamental arts of life, was supplied by the energies of British genius, in the invention of machinery, both for the improvement of Agriculture and Manufactures ; with the produce of these, other Nations, as well as her own population, were supplied, and the deficiencies in other export goods, were in a great measure, made up by an extra demand at home, occasioned by the stimulus given to Agriculture ; and though the Government demands were excessive, taxes were never paid with greater facility. The energies of Britain, however, were not merely displayed in a civil capacity, she triumphed in arms as well as in arts ; her resources and example finally prevailed in the restoration of general peace ; and much of the human power, so long employed in sustaining the sanguinary and protracted conflict, now are returned into the peaceful channels of civil industry.

The mechanical powers, which our unexampled stimulus had called into being, remained in operation, the ravages of war had exhausted the revenues of Foreign States and impaired those of Britain, and consequently, diminished the demand of her genius and industry. It therefore only remains to employ these accessions of power in the way most beneficial to society ; employed they must be or evil consequences inevitably follow ; and as it is from the soil that human subsistence is derived, an increase in the energy of its

productions would obviously be the most advantageous.

In addition to these considerations, various other circumstances, peculiar to Great Britain, tend to enforce the necessity and enhance the importance of a superior cultivation and management of its landed property. Britain is the most populous Nation in Europe; for in no other instance, do we find a single compact Empire exactly defended, identically governed, and peopled by more than 22,000,000 of inhabitants on the same extent of surface; no nation has so many large cities and towns, nor does any employ so great a proportion of its inhabitants, in Trade, Manufactures, and Commerce; no people contribute so largely to the revenue of the State, or to the maintenance of the poor, as the British; in no country are the necessaries of life so high, or the demands for them so great, as in Britain.

The responsibility which attaches to the Landowners of Britain, is of no common kind, whether we regard them as individuals, as patriots, or as philanthropists. Happily for the Country, almost daily examples prove that few of them seem disposed to merge the more sacred of these characters in the more sordid.

Let not any Proprietor hastily conclude, that his Estate is incapable of improvement, or that the subject is unworthy of his attention; as, on a closer inquiry, both these positions may prove false, and in many instances, such an inquiry will lead to the conclusion, that the subject affords full scope for the employment

of his abilities, the exercise of his genius, and the faithful discharge of that trust, which Providence has reposed in him; nor are examples wanting, to show that these efforts are always accompanied by their corresponding remuneration. They are, however, by no means restricted to the narrow sphere of self interest, they assume a more expanded form—and, if properly directed, become a public as well as a private benefit: embracing both the physical amelioration, and the moral advancement, of all within their influence.

CHAP. II.

ON AGRICULTURAL CHEMISTRY, ITS OBJECTS AND EFFECTS; AND ON THE MANURES, ACCORDING TO CHEMICAL TESTS, BEST ADAPTED TO THE AMELIORATION OF DIFFERENT SOILS.

“AGRICULTURAL CHEMISTRY, has for its objects, all those changes in the arrangement of matter connected with the growth and nourishment of plants; the comparative values of their produce as food; the constitution of soils; the manner in which lands are enriched by manure, or rendered fertile by the different processes of cultivation. Inquiries of such a nature, cannot but be interesting and important, both to the theoretical agriculturist, and to the practical farmer. To the first, they are necessary in supplying most of the fundamental principles on which the theory of the art depends. To the second, they are useful in affording simple and easy experiments for directing his labours, and for enabling him to pursue a certain and systematic plan of improvement.

It is scarcely possible to enter upon any investigation in Agriculture, without finding it connected, more or less, with doctrines or elucidations derived from Chemistry.

If land be unproductive, and a system of ame-

liorating it is to be attempted, the sure method of obtaining the object is by determining the cause of its sterility, which must necessarily depend upon some defect in the constitution of the soil, which may be easily discovered by Chemical analysis.

Some lands, of good apparent texture, are yet steril in a high degree; and common observation and common practice afford no means of ascertaining the cause, or of removing the effect. The application of Chemical tests, in such cases, is obvious; for the soil must contain some noxious principle, which may be easily discovered, and probably easily destroyed.

Are any of the salts of iron present? They may be decomposed by lime.—Is there an excess of silicious sand? The system of improvement must depend on the application of clay and calcareous matter.—Is there a defect of calcareous matter? The remedy is obvious.—Is an excess of vegetable matter indicated? It may be removed by liming, paring, and burning.—Is there a deficiency of vegetable matter? It is to be supplied by manure.

A question concerning the different kinds of limestone to be employed in cultivation often occurs. To determine this fully in the common way of experience, would demand a considerable time, perhaps some years, and trials which might be injurious to crops; but by simple Chemical tests, the nature of a limestone is discovered in a few minutes; and the fitness of its application, whether as a manure for different soils, or as a cement, determined.

Peat earth, of a certain consistence and composition, is an excellent manure; but there are some varieties of peats, which contain so large a quantity of ferruginous matter, as to be absolutely poisonous to plants. Nothing can be more simple, than the Chemical operation for determining the nature, and the probable uses of a substance of this kind.

There has been no question, on which more difference of opinion has existed, than that of the state in which manure ought to be ploughed into the land; whether recent, or when it has gone through the process of fermentation? and this question, is still a subject of discussion: but whoever will refer to the simplest principles of Chemistry, cannot entertain a doubt on the subject. As soon as dung begins to decompose, it throws off its volatile parts, which are the most valuable and most efficient. Dung, which has fermented, so as to become a mere soft cohesive mass, has generally lost from one third to one half of its most useful constituent elements; and that it may exert its full action upon the plant, and lose none of its nutritive powers, it should evidently be applied much sooner, and long before decomposition, has arrived at its ultimate results.

By methods of analysis dependant upon Chemical and Electrical instruments, discovered in late times; it has been ascertained that all the varieties of material substances may be resolved into a comparatively small number of bodies, which, as they are not capable of being decomposed, are considered in the present

state of Chemical knowledge as elements. The bodies incapable of decomposition, at present known, are fifty-two. Of these, forty are metals ; eight are inflammable bodies ; and five are substances, which unite with metals and inflammable bodies, and form with them acids, alkalies, earths, or other analagous compounds. The Chemical elements, acted upon by attractive powers, combine in different aggregates. In their simpler combinations, they produce various crystalline substances, distinguished by the regularity of their forms. In more complicated arrangements, they constitute the varieties of vegetable and animal substances, bear the higher character of organization, and are rendered subservient to the purposes of life. And by the influence of heat, light and electrical powers, there is a constant series of changes ; matter assumes new forms, the destruction of one order of beings tends to the conservation of another ; solution and consolidation, decay and renovation, are connected, and whilst the parts of the system continue in a state of fluctuation and change, the order and harmony of the whole, remain unalterable.

The Chemical composition of plants has, within the last ten years, been elucidated by the experiments of a number of Chemical Philosophers, both in this and other countries, and it forms a beautiful part of general Chemistry ; it is too extensive to be treated of minutely ; but it will be necessary to dwell upon such parts of it, as afford practical inferences.

If the organs of plants be submitted to Chemical

analysis, it is found that their almost infinite diversity of form, depends upon different arrangements and combinations of a very few of the elements; seldom more than seven or eight belong to them, and three constitute the greatest part of their organized matter; and according to the manner in which these elements are disposed, arise the different properties of the products of vegetation, whether employed as food, or for other purposes and wants of life.

The value and uses of every species of agricultural produce, are most correctly estimated and applied, when practical knowledge is assisted by principles derived from Chemistry. The compounds in vegetables really nutritive, as the food of animals, are very few; farina or the pure matter of starch, gluten, sugar, vegetable jelly, oil, and extract. Of these, the most nutritive is gluten, which approaches nearest in its nature to animal matter, and which is the substance that gives to wheat its superiority over other grain. The next in order as to nourishing power is oil, then sugar, then farina; and last of all, gelatinous and extractive matters. Simple tests of the relative nourishing powers of the different species of food, are the relative quantities of these substances that they afford by analysis; and though taste and appearance must influence the consumption of all articles in years of plenty, yet they are less attended to in times of scarcity, and on such occasions, this kind of knowledge may be of the greatest importance. Sugar, and farina or starch, are very similar in composition, and are

capable of being converted into each other by simple Chemical processes.

All the varieties of substances found in plants, are produced from the sap, and the sap of plants is derived from water or from the fluids of the soil, and it is altered by, or combined with principles derived from, the atmosphere.

The necessity of water to vegetation, and the luxuriance of the growth of plants connected with the presence of moisture in the southern countries of the Old Continent, led to the opinion so prevalent in the early schools of philosophy, that water was the great productive element, the substance from which all things were capable of being composed, and into which they were finally resolved. The observation of the Poet, "water is the noblest," seems to have been an expression of this opinion, adopted by the Greeks from the Egyptians, taught by THALES, and revived by the alchymists in late times. VAN HELMONT, in 1610, conceived that he had proved, by a decisive experiment, that all the products of vegetables were capable of being generated from water. His results were shewn to be fallacious by WOODWARD in 1691; but the true use of water in vegetation was unknown till 1785; when Mr. CAVENDISH made the discovery, that it was composed of two elastic fluids or gases, inflammable gas or hydrogene, and vital gas or oxygene.

Air, like water, was regarded as a pure element by most of the ancient philosophers: a few of the

Chemical inquirers in the sixteenth and seventeenth centuries, formed some happy conjectures respecting its real nature. Sir KENELM DIGBY in 1660, supposed that it contained some saline matter, which was an essential food of plants. BOYLE, HOOK, and MAYOW, between 1665 and 1680, stated, that a small part of it only was consumed in the respiration of animals, and in the combustion of inflammable bodies; but the true statical analysis of the atmosphere is comparatively a recent labour achieved towards the end of the last century by SCHEELE, PRIESTLEY and LAVOISIER. These celebrated men shewed that its principal elements are two gases, oxygene and azote, of which the first is essential to flame, and to the life of animals, and that it likewise contains small quantities of aqueous vapour, and of carbonic acid gas; and LAVOISIER proved, that this last body is itself a compound elastic fluid, consisting of charcoal dissolved in oxygene.

JETHRO TULL, in his treatise on Horse-hoeing, published in 1733, advanced the opinion, that minute earthy particles supplied the whole nourishment of the vegetable world; that air and water were chiefly useful in producing these particles from the land; and that manures acted in no other way than in ameliorating the texture of the soil; in short, that their agency was mechanical. This ingenious author of the *New System of Agriculture*, having observed the excellent effects produced in farming, by a minute division of the soil, and the pulverization of it by exposure to dew and air, was misled, by carrying his principles

too far. DUHAMEL, in a work printed in 1754, adopted the opinion of TULL, and stated, that by finely dividing the soil, any number of crops might be raised in succession from the same land. He attempted also to prove, by direct experiments, that vegetables of every kind were capable of being raised without manure. This celebrated horticulturist lived, however, sufficiently long to alter his opinion. The results of his later and more refined observations led him to the conclusion, that no single material afforded the food of plants. The general experience of farmers had long before convinced the unprejudiced of the truth of the same opinion, and that manures were absolutely consumed in the process of vegetation. The exhaustion of soils, by carrying off corn crops from them, and the effects of feeding cattle on lands, and of preserving their manure, offer familiar illustrations of the principle; and several philosophical inquirers, particularly HASSENFRATZ and SAUSSURE, have shewn by satisfactory experiments, that animal and vegetable matters deposited in soils, are absorbed by plants, and become a part of their organized matter. But though neither water, nor air, nor earth, supplies the whole of the food of plants, yet they all operate in the process of vegetation. The soil is the laboratory in which the food is prepared. No manure can be taken up by the roots of plants, unless water is present; and water or its elements exist in all the products of vegetation. The Germination of Seeds does not take place without the presence of air or oxygene gas; and in the sun-

shine, vegetables decompose the carbonic acid gas of the atmosphere, the carbon of which is absorbed, and becomes a part of their organized matter; and the oxygene gas, the other constituent, is given off, and in consequence of a variety of agencies, the economy of vegetation is made subservient to the general order of the system of nature.

It is shewn by various researches, that the constitution of the atmosphere has been always the same since the time that it was first accurately analysed; and this must, in a great measure, depend upon the powers of plants to absorb or decompose the putrifying or decaying remains of animals and vegetables, and the gaseous effluvia which they are constantly emitting. Carbonic Acid Gas is formed in a variety of processes of fermentation and combustion, and in the respiration of animals; and as yet no other process is known in nature by which it can be consumed, except vegetation. Animals produce a substance which appears to be a necessary food of vegetables; vegetables evolve a principle necessary to the existence of animals; and these different classes of beings seem to be thus connected together in the exercise of their living functions, and to a certain extent made to depend upon each other for their existence. Water is raised from the ocean, diffused through the air, and poured down upon the soil, so as to be applied to the purposes of life. The different parts of the atmosphere are mingled together by winds or changes of temperature, and successively brought in contact with the surface of the earth, so as to

exert their fertilizing influence. The modifications of the soil, and the application of manures, are placed within the power of man, as if for the purpose of awakening his industry, and of calling forth his powers.

Plants are found by analysis to consist principally of charcoal and aëriform matter. They give out by distillation volatile compounds, the elements of which are pure air, inflammable air, coally matter, and azote, or that elastic substance, which forms a great part of the atmosphere, and which is incapable of supporting combustion. These elements they gain, either by their leaves from the air, or by their roots from the soil. All manures from organized substances contain the principles of vegetable matter, which during putrefaction, are rendered either soluble in water or aëreiform—and in these states they are capable of being assimilated to the vegetable organs. No one principle affords the pabulum of vegetable life; it is neither charcoal nor hydrogen, nor azote, nor oxygen, alone; but all of them together in various states and various combinations. Organic substances, as soon as they are deprived of vitality, begin to pass through a series of changes, which end in their complete destruction, in the entire separation and dissipation of the parts. Animal matters are the soonest destroyed by the operation of air, heat, and light. Vegetable substances yield more slowly, but finally obey the same laws. The periods of the application of manures from decomposing animal and vegetable substances, depend upon the knowledge of these principles.

The Chemistry of the more simple manures, the manures which act in very small quantities, such as gypsum, alkalies, and various saline substances, has hitherto been exceedingly obscure. It has been generally supposed, that these materials act in the vegetable economy, in the same manner as condiments or stimulants, in the animal economy, and that they render the common food more nutritive. It seems, however, a much more probable idea, that they are actually a part of the true food of plants, and that they supply that kind of matter to the vegetable fibre, which is analogous to the bony matter in animal substances.

The operation of gypsum, it is well known, is extremely capricious in this country, and no certain data has hitherto been offered for its application.

There is, however, good ground for supposing that the subject will be fully elucidated by Chemical inquiry. Those plants which seem most benefited by its application, are plants which always afford it on analysis. Clover, and most of the artificial grasses, contain it, but it exists in very minute quantity only in barley, wheat and turnips. Many peat ashes, which are sold at a considerable price, consist in great part of gypsum, with a little iron; and the first seems to be their most active ingredient. I have examined several of the soils to which these ashes are successfully applied, and I have found in them no sensible quantity of gypsum. In general, cultivated soils contain sufficient of this substance for the use of the grasses; in such cases, its application cannot be advantageous.

For plants require only a certain quantity of manure; an excess may be detrimental, and cannot be useful.

The theory of the operation of alkaline substances, is one of the parts of the Chemistry of Agriculture, most simple and distinct. They are found in all plants, and therefore may be regarded as amongst their essential ingredients. From their powers of combination, likewise, they may be useful in introducing various principles into the sap of vegetables, which may be subservient to their nourishment.

The fixed alkalies, which were formerly regarded as elementary bodies, it has been my good fortune to decompose. They consist of pure air united to highly inflammable metallic substances; but there is no reason to suppose, that they are reduced into their elements, in any of the processes of vegetation.

Slacked lime was used by the Romans for manuring the soil in which fruit trees grew. This we are informed by PLINY. Marl had been employed by the Britons and the Gauls from the earliest times, as a top-dressing for land. But the precise period in which burnt lime first came into general use in the cultivation of land, is, I believe, unknown. The origin of the application, from the early practices, is sufficiently obvious; a substance, which had been used with success in gardening, must have been soon tried in farming; and in countries, where marl was not to be found, calcined limestone would be naturally employed as a substitute.

The elder writers on Agriculture, had no correct

notions of the nature of lime, limestone, and marl, or of their effects; and this was the necessary consequence of the imperfection of the Chemistry of the age. Calcareous matter was considered by the alchymists, as a peculiar earth, which, in the fire, became combined with inflammable acid; and EVELYN and HARTLIB, and still later, LISLE, in their works on Husbandry, have characterized it merely as a hot manure of use in cold lands. It is to Dr. BLACK, of Edinburgh, that our first distinct rudiments of knowledge on the subject are owing. About the year 1755, this celebrated professor proved, by the most decisive experiments, that limestone and all its modifications, marbles, chalks and marls, consist principally of peculiar earth, united to an ærial acid: that the acid is given out in burning, occasioning a loss of more than 40 per cent., and that the lime, in consequence, becomes caustic.

These important facts, immediately applied with equal certainty, to the explanation of the uses of lime, both as a cement and a manure. As a cement, lime, applied in its caustic state, acquires its hardness and durability, by absorbing the ærial (or, as it has been since called carbonic) acid, which always exists in small quantities in the atmosphere; it becomes, as it were, again limestone.

Chalks, calcareous marls, or powdered limestones, act merely by forming an useful earthy ingredient of the soil, and their efficacy is proportioned to the deficiency of calcareous matter, which, in larger or smaller quantities, seems to be an essential ingredient of all

fertile soils; necessary, perhaps, to their proper texture, and as an ingredient in the organs of plants.

Burnt lime, in its first effect, acts as a decomposing agent upon animal or vegetable matter, and seems to bring it into a state, in which it becomes more rapidly a vegetable nourishment; gradually, however, the lime is neutralized by carbonic acid, and converted into a substance, analogous to chalk; but, in this case, it more perfectly mixes with the other ingredients of the soil, is more generally diffused and finely divided; and it is probably more useful to land, than any calcareous substance in its natural state.

The most considerable fact made known, with regard to limestone within the last few years, is owing to Mr. TENNANT. It had been long known, that a particular species of limestone, found in different parts of the north of England, when applied, in its burnt and slacked state, to land, in considerable quantities, occasioned sterility, or considerably injured the crops, for many years. Mr. TENNANT, in 1800, by a Chemical examination of this species of limestone, ascertained that it differed from common limestones, by containing magnesian earth; and, by several experiments, he proved, that this earth was prejudicial to vegetation, when applied in large quantities, in its caustic state. Under common circumstances, the lime from the magnesian limestone is, however, used in moderate quantities, upon fertile soils in Leicestershire, Derbyshire, and Yorkshire, with good effect; and it may be applied in greater quantities, to soils, containing very large

proportions of vegetable matter. Magnesia, when combined with carbonic acid gas, seems not to be prejudicial to vegetation, and in soils, rich in manure, it is speedily supplied with this principle, from the decomposition of the manure.

The Chemical theory of fallowing, is very simple. Fallowing affords no new source of riches to soil. It merely tends to produce an accumulation of decomposing matter, which in the common course of crops, would be employed as it is formed, and it is scarcely possible to imagine a single instance of a cultivated soil, which can be supposed to remain fallow for a year with advantage to the farmer. The only cases where this practice is beneficial, seems to be in the destruction of weeds, and for cleansing foul soils.

It is obvious, that in all cases, paring and burning, must destroy a certain quantity of vegetable matter, and must be principally useful in cases in which there is an excess of this matter in soils. Burning, likewise, renders clay less coherent, and in this way, greatly improves their texture, and causes them to be less permeable to water.

The instances in which it must be obviously prejudicial, are those of sandy dry siliceous soils, containing little animal or vegetable matter. Here it can only be destructive, for it decomposes that on which the soil depends for its productiveness.

The advantages of irrigation, though so lately a subject of much attention, were well known to the ancients; and more than two centuries ago, the practice

was recommended to the farmers of our country, by LORD BACON; "meadow-watering," according to the statements of this illustrious personage, (given in his Natural History, in the article Vegetation,) "acts not only by supplying useful moisture to the grass; but likewise the water carries nourishment dissolved in it, and defends the roots from the effects of cold."

No general principles can be laid down respecting the comparative merit of the different systems of cultivation, and the various systems of crops adopted in different districts, unless the Chemical nature of the soil, and the physical circumstances to which it is exposed, are fully known. Stiff coherent soils, are those most benefited by minute division and aëration, and in the drill system of husbandry, these effects are produced to the greatest extent; but still the labour and expense connected with its application, in certain districts, may not be compensated for by the advantages produced. Moist climates are best fitted for raising the artificial grasses, oats, and broad-leaved crops; stiff aluminous soils, in general, are most adapted for wheat crops, and calcareous soils produce excellent sainfoin and clover.

Nothing is more wanting in Agriculture, than experiments, in which all the circumstances are minutely and scientifically detailed. This art will advance with rapidity, in proportion as it becomes exact in its methods. As in physical researches, all the causes should be considered; a difference in the results may be produced, even by the fall of half-an-inch of rain, more

or less, in the course of a season, or a few degrees of temperature, or even by a slight difference in the subsoil, or in the inclination of the land.

Information collected after views of distinct inquiry, would necessarily be more accurate and more capable of being connected with the general principles of science; and a few histories of the results of truly philosophical experiments in Agricultural Chemistry, would be of more value in enlightening and benefiting the farmer, than the greatest possible accumulation of imperfect trials, conducted merely in the empirical spirit. It is no unusual occurrence for persons who argue in favour of practice and experience, to condemn generally, all attempts to improve Agriculture, by philosophical inquiries and Chemical methods. That much vague speculation may be found in the works of those who have lightly taken up Agricultural Chemistry, it is impossible to deny. It is not uncommon to find a number of changes rung upon a string of technical terms, such as oxygene, hydrogene, carbon, and azote, as if the science depended upon words, rather than upon things. But this is in fact, an argument for the necessity of the establishment of just principles of Chemistry on the subject. Whoever reasons upon Agriculture, is obliged to recur to this science. He feels that it is scarcely possible to advance a step without it; and if he be satisfied with insufficient views, it is not because he prefers them to accurate knowledge, but generally, because they are more current. If a person journeying in the night, wishes to

avoid being led astray by the ignis fatuus, the most secure method is, to carry a lamp in his own hand.

It has been said, and undoubtedly with great truth, that a philosophical Chemist, would most probably make a very unprofitable business of farming; and this certainly would be the case, if he were a mere philosophical Chemist; and unless he had served his apprenticeship to the practice of the art, as well as to the theory. But there is reason to believe, that he would be a more successful Agriculturist, than a person, equally uninitiated in farming, but ignorant of Chemistry altogether; his science, as far as it went, would be useful to him. But Chemistry, is not the only kind of knowledge required, it forms a small part of the philosophical basis of Agriculture; but it is an important part, and whenever applied in a proper manner, must produce advantages.

In proportion as science advances, all the principles become less complicated, and consequently more useful. And it is then that their application is most advantageously made to the arts. The common labourer can never be enlightened by the general doctrines of philosophy, but he will not refuse to adopt any practice, of the utility of which he is fully convinced, because it has been founded upon these principles. The mariner can trust to the compass, though he may be wholly unacquainted with the discoveries of GILBERT on magnetism, or the refined principles of that science developed by the genius of ÆPINUS. The dyer will use his bleaching liquor, even though he is

perhaps ignorant not only of the constitution, but even of the name of the substance on which its powers depend. The great purpose of Chemical investigation in Agriculture, ought undoubtedly to be the discovery of improved methods of cultivation. But to this end, general scientific principles and practical knowledge are alike necessary. The germs of discovery are often found in rational speculations; and industry is never so efficacious as when assisted by science.

It is from the higher classes of the community, from the proprietors of land; those who are fitted by their education to form enlightened plans, and by their fortunes to carry such plans into execution; it is from these that the principles of improvement must flow to the labouring classes of the community; and in all cases the benefit is mutual; for the interest of the tenantry must be always likewise the interest of the proprietors of the soil. The attention of the labourer will be more minute, and he will exert himself more for improvement when he is certain he cannot deceive his employer, and has a conviction of the extent of his knowledge. Ignorance in the possessor of an estate of the manner in which it ought to be treated, generally leads either to inattention or injudicious practices in the tenant or the bailiff. *‘Agrum pessimum mulctari cujus Dominus non docet sed audit villicum.’*

There is no idea more unfounded than that a great devotion of time, and a minute knowledge of general Chemistry, is necessary for pursuing experiments on the nature of soils or the properties of manures,

Nothing can be more easy than to discover whether a soil effervesces, or changes colour by the action of an acid, or whether it burns when heated ; or what weight it loses by heat ; and yet these simple indications may be of great importance in a system of cultivation. The expense connected with chemical inquiries is extremely trifling ; a small closet is sufficient for containing all the materials required. The most important experiments may be made by means of a small portable apparatus ; a few phials, containing acids, alkalies, and chemical reagents ; some foil and wire of platinum ; a lamp, a crucible, some filtrating paper, some funnels, and glasses for receiving products, are all that can be considered as absolutely essential for pursuing useful researches.

It undoubtedly happens in agricultural chemical experiments conducted after the most refined theoretical views, that there are many instances of failure, for one of success ; and this is inevitable from the capricious and uncertain nature of the causes that operate, and from the impossibility of calculating on all the circumstances that may interfere ; but this is far from proving the inutility of such trials ; one happy result, which can generally improve the methods of cultivation, is worth the labour of a whole life ; and an unsuccessful experiment, well observed, must establish some truth, or tend to remove some prejudice.

Even considered merely as a philosophical science, this department of knowledge is highly worthy of cultivation. For what can be more delightful than to

trace the forms of living beings and their adaptations and peculiar purposes; to examine the progress of inorganic matter in its different processes of change, till it attain its ultimate and highest destination; its subserviency to the purposes of man.

Many of the sciences are ardently pursued, and considered as proper objects of study for all refined minds, merely on account of the intellectual pleasure they afford; merely because they enlarge our views of nature, and enable us to think more correctly with respect to the beings and objects surrounding us. How much more, then, is this department of inquiry worthy of attention, in which the pleasure resulting from the love of truth and of knowledge is as great as in any other branch of philosophy, and in which it is likewise connected with much greater practical benefits and advantages. ‘*Nihil est melius, nihil uberius, nihil homine libero dignius.*’

Discoveries made in the cultivation of the earth, are not merely for the time and country in which they are developed, but they may be considered as extending to future ages, and as ultimately tending to benefit the whole human race; as affording subsistence for generations yet to come; as multiplying life, and not only multiplying life, but likewise providing for its enjoyment.”—*Sir H. Davy.*

CHAP. III.

ON THE CONSTITUENT PARTS OF SOILS—THEIR ABSORBENT POWERS WITH RESPECT TO ATMOSPHERIC MOISTURE, &c., ONE GREAT CAUSE OF THE FERTILITY IN PLANTS—ANALYZATION OF SEVERAL SOILS, &c.

SOILS in all cases consist of a mixture of different finely divided earthy matters; with animal or vegetable substances in a state of decomposition, and certain saline ingredients. The earthy matters are the true basis of the soil; the other parts, whether natural, or artificially introduced, operate in the same manner as manures. Four earths generally abound in soils, the aluminous, the siliceous, the calcareous, and the magnesian. These earths, as I have discovered, consist of highly inflammable metals united to pure air or oxygen; and they are not, as far as we know, decomposed or altered in vegetation.

The great use of the soil is to afford support to the plant, to enable it to fix its roots, and to derive nourishment by its tubes, slowly and gradually, from the soluble and dissolved substances mixed with the earths.

That a particular mixture of the earths is connected with fertility, cannot be doubted: and almost

all sterile soils are capable of being improved, by a modification of their earthy constituent parts.

To form a just idea of soils, it is necessary to conceive different rocks decomposed, or ground into parts and powder of different degrees of fineness, some of their soluble parts dissolved by water, and that water adhering to the mass, and the whole mixed with larger or smaller quantities of the remains of vegetables and animals, in different stages of decay.

Many soils are popularly distinguished as *cold*; and the distinction, though at first view it may appear to be founded on prejudice, is really just.

Some soils are much more heated by the rays of the sun, all other circumstances, being equal, than others; and soils brought to the same degree of heat cool in different times, *i. e.* some cool much faster than others.

This property has been very little attended to in a philosophical point of view; yet it is of the highest importance in agriculture. In general, soils that consist principally of a stiff white clay are with difficulty heated; and being usually very moist, they retain their heat only for a short time. *Chalks* are similar in one respect, that they are with difficulty heated; but being drier they retain their heat longer, less being consumed in causing the evaporation of their moisture.

A black soil, containing much soft vegetable matter, is most heated by the sun and air; and the coloured soils, and the soils containing much carbonaceous matter, or ferrugineous matter, exposed under

equal circumstances to the sun, acquire a much higher temperature than pale-coloured soils.

The power of the soil to absorb water by cohesive attraction depends in great measure upon the state of division of its parts; the more divided they are, the greater is their absorbent power. The different constituent parts of soils likewise appear to act, even by cohesive attraction, with different degrees of energy. Thus vegetable substances seem to be more absorbent than animal substances; animal substances more so than compounds of alumina and silicia; and compounds of alumina and silicia more absorbent than carbonates of lime and magnesia; these differences may, however, possibly depend upon the differences in their state of division, and upon the surface exposed.

The power of soils to absorb water from air is much connected with fertility. When this power is great, the plant is supplied with moisture in dry seasons; and the effect of evaporation in the day is counteracted by the absorption of aqueous vapour from the atmosphere, by the interior parts of the soil during the day, and by both the exterior and interior during night.

The stiff clays, approaching to pipe clays in their nature, which take up the greatest quantity of water when it is poured upon them in a fluid form, are not the soils that absorb most moisture from the atmosphere in dry weather. They cake, and present only a small surface to the air; and the vegetation on them is generally burnt up almost as readily as on sands.

The soils that are most efficient in supplying the plant with water by atmospheric absorption, are those in which there is a due mixture of sand, finely divided clay, and carbonate of lime, with some animal or vegetable matter; and which are so loose and light as to be freely permeable to the atmosphere. With respect to this quality, carbonate of lime and animal and vegetable matter are of great use in soils: they give absorbent power to the soil without giving it likewise tenacity; sand, which also destroys tenacity, on the contrary, gives little absorbent power.

I have compared the absorbent powers of many soils with respect to atmospheric moisture, and I have always found it greatest in the most fertile soils; so that it affords one method of judging of the productiveness of land.

1000 parts of a celebrated soil from Ormistown, in East Lothian, which contained more than half its weight of finely divided matter, of which eleven parts were carbonate of lime, and nine parts vegetable matter, when dried at 212° , gained in an hour by exposure to air saturated with moisture, at temperature, 62° , 18 grains.

1000 parts of a very fertile soil from the banks of the river Parret, in Somersetshire, under the same circumstances, gained 16 grains.

1000 parts of a soil from Mersea, in Essex, worth 45 shillings an acre, gained 13 grains.

1000 grains of a fine sand from Essex, worth 28 shillings an acre, gained 11 grains.

1000 of a coarse sand worth 15 shillings an acre, gained only eight grains.

1000 of the soil of Bagshot-heath gained only 3 grains.

Water, and the decomposing animal and vegetable matter existing in the soil, constitute the true nourishment of plants; and as the earthy parts of the soil are useful in retaining water, so as to supply it in the proper proportions to the roots of the vegetables, so they are likewise efficacious in producing the proper distribution of the animal or vegetable matter; when equally mixed with it they prevent it from decomposing too rapidly, and by their means the soluble parts are supplied in proper proportions.

Besides this agency, which may be considered as mechanical, there is another agency between soils and organizable matters, which may be regarded as chemical in its nature. The earths, and even the earthy carbonates, have a certain degree of chemical attraction for many of the principles of vegetable and animal substances. This is easily exemplified in the instance of alumina and oil; if an acid solution of alumina be mixed with a solution of soap, which consists of oily matter and potassa, the oil and the alumina will unite and form a white powder, which will sink to the bottom of the fluid.

The extract from decomposing vegetable matter, when boiled with pipe clay or chalk, forms a combination by which the vegetable matter is rendered more difficult of decomposition and of solution. Pure silica

and siliceous sands have little action of this kind ; and the soils which contain the most alumina and carbonate of lime are those which act with the greatest chemical energy in preserving manures. Such soils merit the appellation which is commonly given to them of rich soils ; for the vegetable nourishment is long preserved in them, unless taken up by the organs of plants. Siliceous sands, on the contrary, deserve the term hungry, which is commonly applied to them ; for the vegetable and animal matters they contain not being attracted by the earthy constituent parts of the soil, are more liable to be decomposed by the action of the atmosphere, or carried off from them by water.

In most of the black and brown rich vegetable moulds, the earths seem to be in combination with a peculiar extractive matter, afforded during the decomposition of vegetables : this is slowly taken up, or attracted from the earths by water, and appears to constitute a prime cause of the fertility of the soil.

The standard of fertility of soils for different plants, must vary with the climate ; and must be particularly influenced by the quantity of rain.

The power of soils to absorb moisture ought to be much greater in warm or dry counties, than in cold and moist ones : and the quantity of clay, or vegetable or animal matter they contain, greater. Soils also on declivities, ought to be more absorbent than in plains or in the bottom of vallies. Their productiveness likewise is influenced by the nature of the sub-soil or the stratum on which they rest.

When soils are immediately situated upon a bed of rock or stone, they are much sooner rendered dry by evaporation, than where the sub-soil is of clay or marl ; and a prime cause of the great fertility of the land, in the moist climate of Ireland, is the proximity of the rocky strata to the soil.

A clayey sub-soil will sometimes be of material advantage to a sandy soil ; and in this case it will retain moisture in such a manner as to be capable of supplying that lost by the earth above, in consequence of evaporation, or the consumption of it by plants.

A sandy, or gravelly sub-soil, often corrects the imperfections of too great a degree of absorbent power in the true soil.

In calcareous countries, where the surface is a species of marl, the soil is often found only a few inches above the limestone ; and its fertility is not impaired by the proximity of the rock : though in a less absorbent soil, this situation would occasion barrenness ; and the sandstone and limestone hills in Derbyshire and North Wales may be easily distinguished at a distance in summer by the different tints of the vegetation. The grass on the sandstone hills usually appears brown and burnt up ; that on the limestone hills, flourishing and green.

In devoting the different parts of an estate to the necessary crops, it is perfectly evident from what has been said, that no general principle can be laid down, except when all the circumstances of the nature, composition, and situation of the soil and sub-soil are known.

The methods of cultivation likewise must be different for different soils. The same practice which will be excellent in one case may be destructive in another.

Deep ploughing may be a very profitable practice in a rich thick soil; and in a fertile shallow soil, situated upon cold clay or sandy sub-soil, it may be extremely prejudicial.

In a moist climate where the quantity of rain that falls annually equals from 40 to 60 inches, as in Lancashire, Cornwall, and some parts of Ireland, a siliceous sandy soil is much more productive than in dry districts; and in such situations, wheat and beans will require a less coherent and absorbent soil than in drier situations; and plants having bulbous roots will flourish in a soil containing as much as 14 parts out of 15 of sand.

Even the exhausting powers of crops will be influenced by like circumstances. In cases where plants cannot absorb sufficient moisture, they must take up more manure. And in Ireland, Cornwall, and the Western Highlands of Scotland, corn will exhaust less than in dry inland situations. Oats, particularly in dry climates, are impoverishing in a much higher degree than in moist ones.—*Sir H. Davy.*

CHAP. IV.

WHAT COMPONENT PARTS CONSTITUTE THE MOST FRUITFUL SOILS—ON MAGNESIA AS A MANURE, AND HOW ITS PRESENCE MAY BE DETECTED IN LIMESTONE—IN WHAT PROPORTION, AND ON WHAT SOILS ITS APPLICATION TO LAND IS ADVANTAGEOUS—AND WHERE AND IN WHAT MANNER IT INJURES THE CROPS.

By the foregoing Lectures on Chemistry, we are first instructed on the origin and formation of soils. 2dly, their nature and constitution. 3dly, their uses so far as they are connected with vegetation. 4thly, we are informed how they obtain, and store up food for growing plants.

It seems, both by experience and theory, that clay and sand are the most bulky ingredients in soils; we also find, by experience, that the most fruitful soils are those which are of a just mixture, or equally blended, so as not to be stubborn or too friable.

With dry and absorbent sub-soils, the thicker the strata of the surface soil the more fruitful; and it is necessary in all cases, that tillage land should be ploughed sufficiently deep to admit the free extension of the roots of such plants as are intended to be culti-

vated in it, otherwise a vigorous growth cannot be expected; or if the bottom or sub-soil is close and holds water in a sluggish or stagnate state, it should be carried off by under or surface drains. Such sub-soils that are hard but permeable, should be deeper ploughed than those that are more loose and friable; if permeable beneath, the plough furrow should be broken through or loosened so as to admit a circulation of air and moisture as deep as the roots of plants generally extend.

It appears that the next substance in bulk to clay and sand, requisite to constitute a good soil, is the calcareous earths, such as marl, chalk, or carbonate of lime (which is simply powdered limestone,) and where such calcareous earths are wanting, industry should be employed to supply the deficiency.

Magnesia is one of the smaller ingredients requisite to constitute a fruitful soil. Its operation in the soil seems to be nearly similar to lime. Indeed, it appears by science, that many limestone rocks contain magnesia, and those rocks that contain it in abundance, and where it has been used liberally for agricultural purposes, it has proved injurious to the crops. It appears also, that this is owing to its retaining its caustic state longer than the pure lime, and of it having been applied in too great quantities.

On the poorer soils, Mr. Naismeth says, it neither receives water so rapidly, nor parts with it so freely, as lime, and it seems in this respect to hold an intermediate property between clay and lime.

Sir H. Davy again says—the subject of the application of the magnesian limestone is one of great interest.

It had been long known to farmers in the neighbourhood of Doncaster, that lime made from a certain limestone applied to the land often injured the crops considerably. Mr. Tennant, in making a series of experiments upon this peculiar calcareous substance, found that it contained magnesia; and on mixing some calcined magnesia with soil, in which he sowed different seeds, he found that they either died, or vegetated in a very imperfect manner, and the plants were never healthy. And with great justice and ingenuity, he referred the bad effects of the peculiar limestone to the magnesian earth it contains.

In making some inquiries concerning this subject, I found that there were cases in which this magnesian limestone was used with good effect.

Amongst some specimens of limestone, which Lord Somerville put into my hands, two marked as peculiarly good, proved to be magnesian limestones. And lime made from the Breedon limestone is used in Leicestershire, where it is called hot lime; and I have been informed by farmers in the neighbourhood of the quarry, that they employ it advantageously in small quantities, seldom more than 25 or 30 bushels to the acre; and that they find it may be used with good effect in larger quantities upon rich land.

A minute chemical consideration of this question, will lead to its solution.

Magnesia has a much weaker attraction for carbonic acid than lime, and will remain in the state of caustic or calcined magnesia for many months, though exposed to the air. And as long as any caustic lime remains, the magnesia cannot be combined with carbonic acid, for lime instantly attracts carbonic acid from magnesia.

When a magnesian limestone is burnt, the magnesia is deprived of carbonic acid much sooner than the lime; and if there is not much vegetable or animal matter in the soil to supply, by its decomposition, carbonic acid, the magnesia will remain for a long while in the caustic state; and in this state, acts as a poison to certain vegetables. And that more magnesian lime may be used upon rich soils, seems to be owing to the circumstance, that the decomposition of the manure in them supplies carbonic acid. And magnesia in its mild state, *i.e.* fully combined with carbonic acid, seems to be always an useful constituent of soils. I have thrown carbonate of magnesia (procured by boiling the solution of magnesia in super-carbonate of potassa) upon grass, and upon growing wheat and barley, so as to render the surface white; but the vegetation was not injured in the slightest degree. And one of the most fertile parts of Cornwall, the Lizard, is a district in which the soil contains mild magnesian earth.

The Lizard Downs bear a short and green grass, which feeds sheep, producing excellent mutton; and the cultivated parts are amongst the best corn lands in the county.

That the theory which I have ventured to give of the operation of magnesian lime is not unfounded, is shown by an experiment which I made expressly for the purpose of determining the true nature of the operation of this substance. I took four portions of the same soil ; with one I mixed 1-20th of its weight of caustic magnesia, with another I mixed the same quantity of magnesia and a proportion of a fat decomposing peat, equal to one-fourth of the weight of the soil. One portion still remained in its natural state : and another was mixed with peat without magnesia. The mixtures were made in December, 1806 ; and in April, 1807, barley was sown in all of them. It grew very well in the pure soil ; but better in the soil containing the magnesia and peat ; and nearly as well in the soil containing peat alone : but in the soil containing the magnesia alone, it rose very feeble, and looked yellow and sickly.

I repeated this experiment in the summer of 1810, with similar results ; and I found that the magnesia in the soil mixed with peat became strongly effervescent, whilst the portion in the unmixed soil gave carbonic acid in much smaller quantities. In the one case the magnesia had assisted in the formation of a manure, and had become mild ; in the other case it had acted as a poison.

It is obvious from what has been said, that lime from the magnesian limestone may be applied in large quantities to peats ; and that where lands have been injured by the application of too large a quantity of

magnesian lime, peat will be a proper and efficient remedy.—Magnesian limestone effervesces little when plunged into an acid. A simple test of magnesia in a limestone is this circumstance, and its rendering diluted nitric acid, or aquafortis, milky. Magnesian limestones are usually coloured brown, or a pale yellow. They are found in Somersetshire, Leicestershire, Derbyshire, Shropshire, Durham, and Yorkshire. It is understood that this limestone makes the best lime for cement used in water works.—*Sir H. Davy.*

From the foregoing theory we learn, that lime made from limestone containing magnesia should not be applied to tillage land in great quantities, unless the land be rich, or well stored with decomposable vegetable and animal matter; for otherwise it holds its caustic, and injures the succeeding crops. Every one knows that lime alone will not make poor land rich, and when applied to hungry land in large quantities, it often renders it more infertile. We find by theory, that one of its principal uses as manure, is to convert insoluble into soluble matter; and to correct acid qualities, already in the soil, which otherwise would be injurious to the crops.

Common lime in all cases has the same effect, and is injurious to crops until it has lost its caustic properties; yet it appears by theory, no land can be so fruitful that does not contain carbonate of lime, chalk,* or other calcareous earths. And it also appears by theory, that all earthy ingredients found in the ashes of plants are obtained from the soil, and are

necessary ingredients in the soil ; amongst which, lime is the greatest in substance, and is found in the ashes of most plants. Gypsum, magnesia, alumina, silica or the earth of flints, are all found in the ashes of plants, but in a more minute quantity.

Acids, alkalies, potassa, sulphur, and the numerous saline properties, are said to be mostly generated in the plant, and not taken up by the organs of the plant from the soil, but some parts of the acids are absorbed by the leaf of the plant from the fluids of the atmosphere.

The quantities and qualities of mucilage, saccharine matter, gluten, and the other numerous extracts, seem to be generated in the plant, according to its nature and power of generation, connected with situation, climate, and soil, and are matured by the different chemical operations and changes, in the nature of their constituent properties.

CHAP. V.

ON SOILS, AND THEIR ADAPTATION TO THE GROWTH
OF WHEAT—ON DISEASES, &c. MILDEW, BLIGHT,
SMUT—WIRE-WORM—WEEDS—PREVENTIVE OF
SMUT—EFFECTS OF SALT.

HISTORY furnishes posterity with an account of the different varieties of cultivated GRASSES, to which tribe the plant of WHEAT, the most essential of all others, for the consideration of man, belongs. But it is not in my power, if it were in my province, to say, when, and in what manner, those important changes and improvements have been effected in that vegetable, which has now become, in Europe at least, and in most other parts of the world, where it has been introduced, and could be cultivated with success, indispensable to the health and comfort of man.

I shall, therefore, confine myself to a few remarks, grounded upon my own experience, on the changes and effects incident to the health of that plant. In taking a review of the cultivation of Wheat, I shall not only consider it as an essential, but in this country, a leading article in husbandry. A leading article, because the value of the other productions of the English farmer are principally governed by the price of wheat;

and essential, because that crop, generally returns a more certain profit to the grower, and because persons of every description are interested in its production.

The vegetable, as well as the animal creation, consists of various members, all organized and suited to supply that nourishment which is necessary to the support of life in a healthful state. But vegetation in plants, (which may be considered as equal to vitality in the animal body,) is subject to sickness and disease, and requires caution and care, even with the most skilful managers, to guard as much as possible against their occurrence. Though Paul may plant, and Apollos may water, yet God giveth the increase; and all that can be required of the cultivator is, to plant the greatest breadth consistent with his own interest; always bearing in mind that quantity and quality are the legitimate end of improvement. Yet, even with the most judicious managers, they must be governed by the situation and nature of the soil.

The deep loams and marly land, on a dry substrata, are most congenial to the growth of wheat, which may be grown alternately on these kinds of soil so as to obtain abundant crops, and consequently to a great profit. The gravelly, flinty, and chalk soils, on a dry bottom, grow the best qualities of wheat. Indeed, as much depends on the dryness and purity of the subsoil, as on the surface, on all kinds of land, as it regards both quantity and quality, of what description soever may be the produce. The latter soils are commonly planted with wheat every fourth or fifth year.

There are various qualities of clay land, all calculated for the production of wheat. Some of them are so stubborn and glutinous that it would be useless, in some particular seasons, to try to fertilize them, under the customary mode of tillage.

Sandy, free-stone, shallow-soiled, and rocky land, are less congenial to the growth of wheat than any other soil; indeed, pure sand, or coarse grit, is not susceptible of vegetation.

Sandy, rocky, or heath soils, could not be cultivated for wheat, were it not for the turnip and clover husbandry giving tenacity and firmness to the surface soil. Wheat, on this sort of land, may be grown with success every sixth or eighth year.

The wheat-plant roots and tillers according to the quality of the land, and the number of the plants. Three bushels of seed per acre, it may be assumed, is about the average quantity, ploughed or harrowed in, or something less if drilled or planted. One bushel per acre, of good seed, will produce three plants to a square foot; a number on good land, sufficient to produce abundance of straw, but not enough to yield a good crop of corn. Wheat-plants, when thin on the ground, often grow too luxuriantly, and are apt to tiller late in the season; and, in consequence, more liable to be affected with the mildew, and more likely to be injured by frosts, and cold blowing winds, than when there is a full stock of plants.

The fibres of wheat-plants have a tendency to strike deep into the earth, as well as horizontally; and

strange as it may appear to those persons who have not looked into the subject, but on sandy or heathy land, where they meet with no resistance, or on strong earths, where holes are made by the worms, or in small clefts of a rock, the roots will often penetrate as deep beneath the surface of the ground, as the straw grows above it; and this is one of the causes that enables wheat to endure drought better than any other grain.

Of wheat, there is a number of varieties; but by far the greatest breadth of ground is planted with the red and white lammas, in this part of the country, and on the average of seasons, there is no doubt but these sorts answer best the purposes of the grower. The cone or bearded sorts, are often grown with success on the deep clays, where there is a dry bottom; but owing to its strong stamina, it would be ruinous to plant this species on light land, as the strong fibres, by meeting with little or no resistance, would strike into the subsoil, whence, from its impurity, the plant would be but sparingly fed, which would cause a partial, or total barrenness in the mealy part of the corn.

The winter wheat, if planted in the spring, will also fail in the fruit, although the spring kind, planted at the same time, will be fruitful: the cause of this is, that the stamina of the former is stronger than that of the latter. The tenderness of the spring sort prevents the roots from penetrating far into the ground, and the fibres are kept near to the surface, consequently both the straw and the ear are well supported. While the winter kind, being sown out of season, the frosts hav-

ing subsided, the plant meeting with no check in the early stage of vegetation, it takes an unnatural growth, both in root and straw, and although the season should prove ever so fine and favourable for ripening, it will be barren of fruit.

Mildew is a calamity, over which the power of man has no control. It is caused by the vicissitudes of the season. The sudden transition of warm to cold weather; or hot days and frosty nights, which check the circulation of the succulent properties, and stagnate in the plant the whole system of vegetation. The fluids then, instead of executing their office, are absorbed by the straw, which is the cause of canker and discolouration. The natural communication between the root and the ear, being thus prematurely cut off, the corn is left to be ripened by the atmosphere. The thinner the stock, the more luxuriant and fuller of fluid are the plants; the shock, in consequence, is more severe, and the disease more fatal.

Blight, or barrenness in wheat, originates in different causes, but the whole of those causes proceed from unpropitious seasons. When the land is dry at sowing-time, the seed germinates slowly; the grain shoots forth but a feeble root, and the stamina, in consequence, becomes sickly, and often continues so to the termination of its growth.

Again, if the autumn and winter prove mild, and the blade spires, instead of branching and curving to the ground, the strength and vigour of the plant are thereby reduced, and blight follows. Sometimes the

absence of heavy rains to close the soil to the roots, causes sickness, and then the cold blowing winds, or the frosts, kill many of the plants, and leave the stock too thin; they are then apt to tiller late in the season, and produce shrivelled corn.

Heavy rains in the summer are the cause of barrenness in two ways. First, they beat down the straw or stem, and prevent the succulent properties of the plant from performing the regular functions assigned to them; and secondly, heavy and repeated showers, while the plant is in blossom, wash off the farina, and cause the ear to be partially set.—Insects are the effect of blight—not the cause.

The smut in wheat is a contagious disease, communicated by the miasm of the smut-ball from one year's crop to another, the cause and operations of which have been but very imperfectly understood; some have attributed it to the seed being grown too often in succession on a similar soil, others have attributed it to the variation of seasons, or that atmospheric air had an influence over particular soils and situations, while others, more rationally supposed, that the grain becomes contaminated and rendered unfit for seed, by growing in crops, where there was smut growing: now time and experience has proved, that neither one or the other of these, are the real or direct causes of smut. The disease is taken into the system, by the root and fibres of the plant; no disease of this kind, can affect the plant, unless the cause is in the soil, and this may be communicated to the land in

various ways ; it may be by miasm of the putrid or carbonated matter of the smut, attached to the bran or external parts of the seed, and this may also happen in various ways ; if it is thrashed in a barn that has had smutted wheat thrashed in it in previous years, more or less of the dust will be lodged on the sills or crevices of the floor, and therefore become mixed with the seed, or if it is put into sacks that have previously held smutted corn, some of the dust will remain and thereby adhere to the grain ; it may also be conveyed to the land, by the manure made from straw that had smut growing amongst it ; or the dung may be impregnated by the dust blown from the barn while winnowing.

This I proved more than fifty years ago, and having become well convinced that the disease was conveyed to the soil in a variety of ways, and afterwards taken into the organs of the plant by the roots. I took the precaution to know the growth of my seed and to be careful what dung I put on my land intended for wheat, and for more than thirty years, though I every year planted more or less wheat, raised on the same farm, and often without any preparation ; but if I suspected any smut, I used a solution of copperas or blue vitriol, dissolved in water, and never after I adopted this method, did I lose sixpence in the sale of any wheat, on account of smut, except by a few bushels, when I neglected to take the above precaution.

It is said by botanists, that the smut in wheat is produced by a very small fungus, which fixes on the

grain—this comes from very high authority, and cannot be doubted ; but a fungus has been discovered on the putrid ball, but this putrid matter, as above observed, is the effect of another cause. Sir H. Davy says—If there is any process for which nature may be connected, most likely to supply resources of this kind, it is that concerned with the reproduction of the species—Again, he says, it seems fair to conclude, that the different earths and saline substances found in the organs of plants, are supplied by the soils in which they grew, and in no cases composed by new arrangements of the elements, in air or water.

The dust of the smut-ball is a carbonated matter, and soluble in the first moisture it comes in contact with, in consequence, is an immediate food for plants.

The wheat-plant has numerous other obstacles to contend with. I have before said, that insects are the effect of blight, a disease which no human foresight is able to prevent. There are also many of the insect tribe, and a number of other small animals, that are propagated beneath, as well as upon the surface of the earth, which appear to be great enemies to this invaluable grain ; but we must at the same time observe, that the same all-wise Providence that created them, has also created a numerous species of birds which have a predominancy over them ; and were it not for the active rapacity of the feathered race, in devouring them, and thus preventing almost to an incalculable extent, their propagation, the slug, and the grubs of different kinds, like the locusts of the east, would

destroy nearly the whole of the tender and more useful vegetables that are grown upon the earth.

The wire-worm often commits depredations upon the young wheat, as well as upon other cultivated plants. These animals are propagated in the roots of the spurious sorts of grasses, and consequently out of the reach of birds. These grasses are often suffered to accumulate, even where a closer system of tillage would be more profitable to the cultivator of the soil.

Wild oats, charlock, poppies, goldings, twitch-grass, and numerous other noxious weeds, demonstrate a bad system of husbandry ; but to point out errors and defects, without showing in what manner those errors may be avoided, and those defects superseded by a system at once more husbandly and profitable, would be an useless and ungenerous employment.

Wheat, in its indigenous state, as a natural production of the soil, appears to have been a very small grass, and like most other plants, has been gradually improved by culture ; and although it may appear at the present day to have arrived at its ultimate perfection, yet this is a subject, the full developement of which, it must be admitted, is far beyond our comprehension. We do know, however, that wonderful improvements have been made in every branch of useful knowledge, and that we can only reason safely from facts. If we cannot imitate the powers of composition belonging to vegetable structures, at least we can understand them, and therefore we ought not to relax our exertions in endeavouring to effect further im-

provements. We know not what light Providence may throw in the way of skill and perseverance. We know that many of the diseases incident to plants, have their source in the constitution of those plants, and that soil and climate will also have their natural influence in producing those effects.

The disease in wheat, called smut, until lately, was considered as a great national calamity; but as the cause of that disease is now better understood than it was formerly, those complaints have diminished, and we shall hear still less about it, as the farmer obtains more experience, and knows better how to avoid conveying that disease to the soil.

Blight, mildew, and smut, were always dreaded by the farmer, as an evil of great magnitude. The latter, is said by botanists, "to be a species of fungus so small as to require glasses to render its form distinct, and rapidly propagates, by its seeds spreading from stalk to stalk, fixing itself in the cells connected with the common tubes, and carries away and consumes that nourishment which should have been appropriated to the grain." We find this by experience, to be very true; but we must not suffer our reason to be led away so far as to suppose that this is the first cause. The fungus, undoubtedly, is the effect of the season, and as I have before said, the disease first shows itself on those plants which are of the most exuberant growth. Some countries are more affected by it than others; some parishes more than others; and some soils, on the same farm, are more subject to the

disease than others. The forward, or early sown crops, in all situations, are those that are generally the least injured. It has been a popular notion amongst farmers, that a barberry tree in the neighbourhood of a field of wheat, often produces mildew, and it is said, they are frequently covered with a fungus; but there is no reason why a barberry tree should not be affected by the same cause that affects a field of wheat growing near it. It is a very common thing to see the latter crops of peas in a garden mildewed, and sometimes the outside leaves of the cabbage growing near them; but there is no reason to suppose the cabbage would not have been mildewed if the peas had not grown near them.

Respecting mildew and blights, we have often the sad experience of what we term calamities, and theory here goes but a little way to render the husbandman any assistance. Happy then, ought we to be that these calamities are in the hands of a supreme and all-wise Providence, and we ought to look upon them as a lesson to awaken and increase our industry, to guard as much as we can, against events we have not the power always to prevent.

I have before said, that mildew has the greatest effect on the plant, when it is in the most exuberant state of growth. A thin stock of plants on the ground often occasions a luxuriant growth, and causes the plant to throw out an additional number of offsets, which backens the plant. Hoeing late in the season, has the same effect, by causing it to tiller late in the

spring. We have the experience in seasons of mildew, of the late crops being most affected. Rye, it is said, is seldom or ever affected by mildew, when it is sown at the latter end of September. This corn was formerly sown amongst the wheat on light lands, or on such as were most subject to mildew, for the rye to prevent the wheat from being affected with that disease. I know of no theory that informs us of any particular operation that rye can have on the wheat to prevent its mildewing; but we know it grows taller than wheat, and has a finer polished epidermis, which is probably the cause of its not mildewing, and in miscible crops, the wheat is generally finer in the straw, than where no rye is grown amongst it; and I have before observed, the coarse strawed wheats hold the most mucilage, and in consequence are the most affected with this disease. Any dressing that might be discovered to check an excess of mucilage in the plant of wheat, would probably have a good effect; and I have some reason to believe, that salt sown on the growing wheat early in the spring, would have this effect. I understand from a respectable farmer, who has tried salt on his growing wheats, that although there was no visible appearance of the salt contributing to the growth of his crop, yet his straw was stronger, and a better yield compared with that which had not been manured with salt. Now this corresponds with science, for Mr. Naismith says—all saline matters, if applied in immoderate quantities, are direct poison to plants; and as it is no direct food for plants, it is

reasonable to suppose, a moderate quantity would check too great an exuberance in the plant, and cause a stronger and firmer straw, and in consequence, a better yield.

Sir H. Davy, in speaking of salt, says—Some persons have argued against the employment of salt; because when used in large quantities, it either does no good, or renders the ground sterile; but this is a very unfair mode of reasoning. That salt, in large quantities, rendered land barren, was known long before any records of agricultural science existed. We read in the Scriptures, that Abimelech took the city of Shechem, “and beat down the city, and sowed it with salt;” that the soil might be for ever unfruitful. Virgil, reprobates a salt soil; and Pliny, though he recommends giving salt to cattle, yet affirms that when strewed over land, it renders it barren. But these are not arguments against a proper application of it. Refuse salt, in Cornwall, which however, likewise contains some of the oil and exuvial of fish, has long been known as an admirable manure.

The Cheshire farmers, contend for the benefit of the peculiar produce of their county; and it is not unlikely that the same causes influence the effects of salt, as those which act in modifying the operation of gypsum. Most lands in this island, particularly those near the sea, probably contain a sufficient quantity of salt for all the purposes of vegetation, and in such cases, the supply of it to the soil will not only be useless, but may be injurious. In great storms, the spray of the

sea has been carried more than fifty miles from the shore ; so that from this source, salt must be often supplied to the soil. It is a constituent likewise of almost every kind of animal and vegetable manure.

We know that the manufacturers of straw goods prefer their straw grown on a chalk or flinty soil, and we find that the cuticle or epidermis of the wheat straw, is composed principally of siliceous earth, but as all vegetables contain more or less of saline properties, it is not improbable but salt may be the ingredient that gives the fine polish to these straws ; which render them more fit for the manufacturer's use ; but whether or not the plant draws the siliceous earth or salt more freely from these soils than other loams, seems to remain for future experiments to discover. The fine thin-skinned wheat from the eastern and southern countries, have often been tried in this country, but the uncertainty of our climate seems to be the cause of their not succeeding.

We hear, from horticulturists and others, a great deal about habit ; and we hear of shrubs and other exotic plants, when first imported into this country, requiring shelter or artificial warmth, but by being inured by degrees to this climate, are often found to succeed in our common atmosphere. It appears one of the principal causes of the early foreign wheat not succeeding in our climate, is their germinating with less moisture than the wheat inured to this climate. A fine thin-skinned wheat, called *Talavera*, was making its way very fast over this island, but a few years

back, and in hot and dry summers was found to possess superior qualities, compared with those inured to this climate ; but in cold and wet seasons, the reverse was the case ; and the cause of its being now rejected, it appears, was its being sown in much too large quantities before it had become inured to the climate.

Mr. Knight has obtained new varieties of wheat, by simply growing different kinds together ; he says, in the *Philosophical Transactions* for 1799—" In the year 1795 and 1796, when almost the whole crop of corn in the island was blighted, the varieties obtained by crossing, alone escaped, though sown in several soils, and in very different situations."

Sir H. Davy says, by applying the pollen or dust of the stamina from one variety to the pistil of another of the same species, a new variety may be easily produced ; and Mr. Knight's experiments seem to warrant the idea, that great advantages may be derived from this method of propagation.

Mr. Knight's large peas, produced by crossing two varieties, are celebrated amongst horticulturists.

Mr. Paget, of Ibstock, found that when he sowed spring wheat in March, it produced shrivelled grain, but when sown on the same kind of land the latter end of April or beginning of May, it produced plump grain.

CHAP. VI.

ON THE PROPER DIVISION OF FARMS—A SIMILE OR
COMPARISON IN FAVOUR OF GOOD HUSBANDRY
—REGULARITY RECOMMENDED — EXPERIENCE
ESSENTIAL TO SYSTEMATIC KNOWLEDGE.

FARMS, in general, are divided into fields, calculated for the various purposes of agriculture. Those are said to be the most eligible, that have a sufficient proportion of meadow and old pasture, with equal divisions of heavy and light loams for tillage, and they cannot be profitable to the occupier when out of condition. Farms may be compared to horses, that are destined to travel full journies on the road daily, throughout the year. The first care of a wise and prudent owner will be to put his horses into a good state of condition, so that they will be able to perform their labour with ease, and he will allow them sufficient provender to keep up that condition. But the more covetous or short-sighted owner, will commence his journey before he has got his horses into proper condition, or stint them in their provender. One irregularity is generally followed by others, and losses and disappointments immediately follow. The horses belonging to the more prudent owner, return at the

end of the year in good condition, and ready to start a second round ; while the others require rest and expense before they can commence a second journey ; and when one owner is at ease, the other is in trouble and anxiety, and suffering under disappointments as well as losses. Again, fields on a farm may be compared to the different breeds of horses : they are all useful when applied to their proper purposes. Teams work best together when they are matched in weight and pace. Heavy lands grow the best beans and wheat—light land, the best turnips and barley. Eight fields of each make two full teams, and should be classed, as to size and action, as nearly as convenience will permit. Regularity, in every business, is the mother of ease and comfort.

It is an opinion generally received, that method in business, is the foundation on which the utility and ornament of a whole fabric, as well as its durability, depends. Knowledge, in the infancy of any art, is necessarily confined to particulars ; but after long observation and experience, the mind begins to generalize facts ; and this is the first step towards the foundation of theory or science, which is nothing more than the substitution of rational principles of action, for habits founded on custom or prejudice. When a number of generalized facts is accumulated, the next process of the mind is to classify, or systematize them ; this is the highest effort in the progress of knowledge ; and that art will be the most perfectly understood as a science, in which the greatest number of facts, or in other words,

the most extensive range of experience and observation, is generalized and arranged in a connected system: amongst which, none afford a wider field for consideration, than the great diversity and qualities of soil, the wisdom of Providence having so arranged it that skill may find its reward. Nothing is more gratifying to the practical farmer, than to see the stubborn unfruitful soil, made prolific by superior management; nor any thing more annoying to his feelings, than to see land, fine and rich by nature, reduced so as to produce nothing but miserable scanty crops, by misapplication. The public also, receive a peculiar gratification, when they hear of land being made fertile by skilful management, and kept in a constant state of productiveness. Nor can one scarcely conceive any thing more mortifying to their feelings, than when they see or hear of land lying idle, or being misapplied, for no visible or rational purpose.

CHAP. VII.

A FARM OF 360 ACRES ELIGIBLY CLASSED—ON A REPETITION OF FARINACEOUS CROPS—EFFECTS OF DIFFERENT CROPS ON THE LAND—KEEP OF HORSES EMPLOYED IN HUSBANDRY—CONSUMPTION OF FOOD BY FEEDING AND OTHER STOCK—WEIGHT OF HERBACEOUS CROPS—FARM SERVANTS, PRODUCE OF THE DAIRY, &c.

I HAVE now made such preliminary remarks and observations as I have thought necessary, and even indispensable, to elucidate and explain the great objects I have in view, in publishing this work; and having done so, I shall commence this chapter by laying before the reader, a series of facts relative to Practical Farming, and demonstrate those facts by a variety of calculations, founded on long experience, and matured by a close and anxious attention to this interesting subject.

I have in the first place, supposed a farm to consist of 360 acres of land, viz.—130 acres of arable and the remainder of meadow and pasture. I have then divided the farm into classes, and appropriated those classes to their most eligible and profitable purposes. I have afterwards, by calculations, shewn what profit

(or rent,) it will produce, by a valuation of the produce, taking it in the most common or customary way. I have also made a calculation of the value of the produce upon the improved system, and from thence I have drawn a comparison between the two systems; and I have finally, pointed out where the improvements might have been made, so as to account for the excess.

CLASS	ACRES
1—Bean and wheat soil,	80
2—Turnip and barley ditto,	50
3—Dairy land,	40
4—Feeding ditto,	40
5—Good store ditto,	40
6—Upland meadow,	20
7—Flat ditto,	20
8—Poor clay store ditto,	70
	——— 360

In order to render the following more plain and intelligible, it may be proper in this place to show the data upon which the particular items are grounded; and although a part of them, unavoidably, must be taken on assumption, yet as they all bear an equivalence to each other, the positions being partly assumptive, cannot affect the principle. Still however, to avoid as much as possible, any objection that might be taken to this plan, I have endeavoured to take a middle course, and by doing so, I trust it will be found that the averages have been as correctly given, as they can possibly be expected in a work of this sort.

It is a well known fact, that the farinaceous crops are the greatest exhausters of the soil; and conse-

quently, the quicker and more frequently those crops are raised on the same soil, the greater will be the expenditure required to recruit the land, to bring it again into its former comparatively strong and healthy state.

Common experience teaches us, that a wheat crop takes out of the land, about 30s. per acre, independently of what it leaves to be converted into manure; oats, about 25s.; and barley, 20s. Beans and peas are supposed to return as much to the land as they take out, especially where a part of the crop is consumed on the farm; or if the whole were to be consumed by pigs and cattle, they would be meliorating crops.

Meadow and clover hay, carried off the farm, reduce the land full 30s. per acre, or something less if consumed on the farm; although they are meliorating crops, in proportion to their bulk, when spent on the farm in a green state.

Turnips, mangel-wurzel (beet), and other roots, except potatoes, are all improvers, when spent on the farm.

Cabbage, rape, rye, and vetches, also contribute to enrich the soil, in proportion to the bulk of crop. The latter crop takes but little out of the land, and whether eaten by sheep on the ground, or spent by horses in the stable or yard, it leaves nearly the third of a manuring for the same breadth of land, being nearly equal to a crop of straw converted into manure.

Horses employed in husbandry require each about 2cwt. 1qr. 14lbs, of clover or other hay, per week;

or other dry food of the same weight. Clover hay at 70s. per ton, will be about 8s. 6d. per week; or 2cwt. of hay, and 70lbs. of mixed corn, is 11s. 9d. per week. Such horses are kept in the summer on green meat, at about 7s. per week, or on an average at 8s. 9d. per week, or £22. 15s. per annum.

Clover, vetches, or grass, when in a full state of mucilage, decrease from two-thirds to three-fourths of their weight in making into hay. A full-sized plough-horse will require about 280lbs. per day, of green vetches, clover, or grass, if in a soft mucilaginous state, while a horse out of labour, though of the same size, would be satisfied with nearly half that quantity. A large ox, or cow in milk, about 160lbs. A grazing heifer, or a small ox, 140lbs. Ewes with their lambs 14lbs. Wether sheep and dry ewes, 12lbs. per day, and younger sheep, in the same proportion, according to their age, &c. But they all decline in quantity according to the state of the weather, and the pasture, down to one-third of the above weight; and this is one of the causes why stock are satisfied, and thrive better in a dry, than in a moist season, with less food.

Dairy cows, and feeding stock, require more land to graze upon, (according to its production,) than store-stock; and although of a quality and condition to produce 35cwt. of hay per acre, and aftermath and herbage equal to half that quantity, is produce sufficient to support a heifer, or small-sized ox, eight-months, yet they would require at least one-third more land to keep them going on in a thriving state; as

they trample down, waste or leave, perhaps one-third part of the herbage for lean stock.

A grazing ox, or heifer, in a lean state, consists of nearly one-half of offals, viz.—the hide, entrails, blood; &c., and add to the quarters, as they gather flesh, three-fifths or five-eighths, independently of the rough fat. Sheep, upon an average, may make about the same progress. It is a good ox that increases 224 lbs. in grazing six months on the best grass land; and a good heifer that adds 168 lbs. to its quarters; and a good sheep that gathers 30 lbs. in the same time.

A good crop of clover will make two tons of hay, and a second crop about 20 cwt. per acre. A full crop of vetches, when in blossom and in a full state of mucilage, will weigh from ten to fourteen tons, and will serve seven horses for a fortnight, at 7*s.* 6*d.* each, per week, which is £5. 5*s.* per acre.

Buck-wheat is sometimes grown on poor heath or sandy soils, for the purpose of ploughing it in as manure; and it is said to be good husbandry, where the farm is not within the reach of other manure. This crop is about equal in bulk to clover or vetches, and I have no hesitation in saying, that if the two latter are eaten on the ground with sheep, they are equally as meliorating, as a white straw crop is exhausting to the land. The straw from a crop of pulse or grain, when converted into manure, affords from one-third to a fourth of a dressing, which is equal to a scanty manuring every third year. Wheat stubble is generally mown and carted to the yards and used for burrowing and litter-

ing cattle. The use of it for this purpose is about equal to the expense of collecting.

Three hundred and sixty acres are considered to be a full sized farm, and is quite sufficient to occupy a person the whole of his time in superintending it. Or, if the farm is managed by a bailiff, at £126. a-year wages, including the market expenses of himself and his horse, that will amount to 7s. per acre. Eight able horses, with the market-horse, and two ploughmen and two boys, at £30. a-year wages, will be able to work it. A shepherd at £12. and a dairy-maid and house-maid at £15. will also be required.

A well selected dairy of cows, grazed on good land, and well managed in the milking, have been known to produce, in a season of nine months, 2,730 quarts of milk each cow; and of this quantity of milk, with very good management, has been made 4cwt. 1qr. of cheese; and the same quantity of milk has produced $21\frac{3}{4}$ dozen of butter. It requires a select dairy of cows, and to be well grazed, for them to produce 12 quarts of milk per day, each cow, for 26 weeks. Five quarts of milk have been known to produce a pound of cheese, and eight quarts a pound of butter.

CHAP. VIII.

AN INVENTORY OF THE CAPITAL REQUIRED TO
WORK THE FOREGOING FARM, SUPPOSING IT TO
BE TAKEN TO AT LADY DAY.

	£.	s.	d.		£.	s.	d.
20 dairy cows,	17	0	0	..each..	340	0	0
24 feeding heifers,.....	12	0	0	..ditto..	288	0	0
12 ditto ditto,	9	0	0	..ditto..	108	0	0
18 store ditto,.....	7	0	0	..ditto..	126	0	0
30 wether sheep,	2	0	0	..ditto..	60	0	0
245 breeding ewes,.....	1	15	0	..ditto..	428	15	0
8 plough horses,	21	10	0	..ditto..	172	0	0
10 sets of harness,.....	3	5	0	..ditto..	32	10	0
2 strong waggons,	20	0	0	..ditto..	40	0	0
2 harvest ditto,	15	0	0	..ditto..	30	0	0
2 strong carts,.....	12	0	0	..ditto..	24	0	0
2 ditto ditto,	8	0	0	..ditto..	16	0	0
1 seed or market ditto,.....					10	0	0
Ploughs and rollers,					30	0	0
Harrows and scuffles,.....					21	0	0
Small implements,.....					5	0	0
Winnowing machine, bins, sacks & barn utensils,					25	0	0
Corn staddles and ladders,					21	0	0
Chaff and root cutters, malt and bean mills,					21	0	0
Troughs and water-pipes,.....					10	0	0
Carried over,.....	£1,808	5	0				

	£.	s.	d.
Brought over,	1,808	5	0
Seeds and seed corn,	108	15	6
Fallows, manure, and other tillage,	237	9	6
Half-a-year's rent and taxes,	284	4	10½
Repairs to fences, drains, water courses, &c.	27	2	6
Mason, carpenter, and materials,	27	2	6
Half-a-year's housekeeping,	135	0	0
Harvesting hay and corn crops,	135	0	0
Household goods,	300	0	0
Brewing and dairy utensils,	60	0	0
Cheese, bacon and beer,	60	0	0
Pigs and poultry,	30	0	0
Fruit trees and planting garden,	10	0	0
	<hr/>		
	£3,222	19	10½
If taken to at Michaelmas, then £. s. d.			
add half-a-year's rent & taxes, 284 4 10½			
Half-a-year's housekeeping, .. 135 0 0			
	<hr/>		
		419	4 10½
	<hr/>		
	£3,642	4	9
	<hr/>		

This is the capital required, if taken to at Michaelmas, except the sale of wool, calves, and lambs; and if a running stock of sheep, £300. might be dispensed with.

CLASS I.

EIGHTY ACRES OF BEAN & WHEAT SOIL.

OUTGOINGS—*when managed in the customary way.*

	£.	s.	d.
Tillage for beans, 21s. 4 ^p acre, seed, 16s. 6d. planting and twice hoeing, 16s., hacking, harvesting, ricking, &c., 16s. 4 ^p acre, car- rying, thrashing, dressing and carting to market, 6d. 4 ^p bushel, or 15s. per acre, ..	42	5	0
Tillage for wheat, equal to three ploughings, 42s. seed, &c. 23s. 6d. ploughing ditto, and dressing the land, water furrow, &c. 15s., harvesting, &c. 16s. 6d. 4 ^p acre, taking-in, thrashing, and carting to market, &c. 10d., or 22s. 6d. per acre,	59	15	0
Fallow, equal to 5 ploughings, 70s., carting dung, made from two crops of straw, 12s. per acre,	41	0	0
Wheat seed, &c. 23s. 6d., ploughing in, trench- ing, dressing, &c. 15s. harvesting, 16s. 6d., thrashing, &c, 22s. 6d.,	38	15	0
Tillage for barley, equal to 4 ploughings, 56s., seed, 16s., weeding and harvesting, 12s. 6d., thrashing, &c. 20s. per acre,	52	5	0
Clover and grass seed, 10s. 6d. per acre, carting, &c. dung from 2 crops of straw, 12s. 4 ^p acre,	11	5	0
Taxes and parish rates, 4s. in the pound, shep- herd, repairs to fences, drains, &c., weeding, &c., carpenter, mason, mole-catcher, &c., hurdles, staddles, small implements, &c., 6s. 6d. per acre,	47	6	8
Occupier, 5 per cent. on his capital, 8s. 6d. super- intending the farm, 7s. per acre, including horse and market expenses, housekeeping, including garden, housemaid and repairs in the house, 15s. per acre,	122	0	0
	<hr/> £414 11 8		

CLASS I.

PRODUCE—when cultivated in the customary way.

A.	R.	P.		£.	s.	d.
10	0	0	Beans, 30 bush. $\frac{1}{4}$ acre, at 44s. $\frac{1}{4}$ qr.	82	10	0
10	0	0	Wheat, 27 ditto, at 60s. ditto,	101	5	0
10	0	0	Fallow,	0	0	0
10	0	0	Wheat, as above,	101	5	0
10	0	0	Barley, 5 qr. per acre, at 32s. per qr.	80	0	0
10	0	0	Clover, 6 sheep to the acre, 26 weeks, improve in wool and carcass, at 16s. 6d. each ; 10 ditto wintered, at 8s. each,	53	10	0
20	0	0	Second and third year's seeds, three sheep per acre, 26 weeks, improve 12s. 6d. each, 20 ditto wintered, at 8s. each,	45	10	0
Forty acres straw, stubble, herbage, pigs and poultry, 25s. per acre, ..				50	0	0
Total produce, ...				514	0	0
Ditto expenses, ..				414	11	8
Rent or profit,				£99	8	4
Per acre, ..				£1	3	10½

This Table gives a more particular account of the different items of expenditure :—

	£.	s.	d.
Three horses' keep, at £22. 15s. each, one man and boy, £15. wages, two labourers, 10s. per week each,	135	5	0
Weeding, reaping, and extra men in harvest, &c.	63	16	0
Tradesmens' bills, materials, hurdles, staddles, &c.	27	10	0
Decrease in value of horses, wear and tear, &c ..	5	10	0
Seeds and seed corn, &c.....	45	0	0
Taxes, highways and rates,.....	16	0	0
Housekeeping, use of capital, superintendence, &c	122	0	0
Rent,	99	8	4
	<hr/>		
Amount of expenditure, &c.	£514	9	4

In the above table, the reader will observe, that there only remains £5 10s. for wear and tear, which every practical farmer knows is much too little ; he also knows that three horses is a less number than is generally employed on eighty acres of arable land. Therefore this proves, that though I have put the ploughings, &c. higher in the other estimate than they are usually calculated at, yet they are not sufficiently high ; but I shall here observe, 4s. in the pound, parish rates, is more than is paid on the average of parishes. Most farmers deceive themselves in calculating the expense of their horse labour ; and I think they do not value the advantages arising from manual labour high enough. Some persons are of an opinion, that by ploughing with oxen instead of horses, there is a great saving of expense ; but when the constitution and activity of the one are compared with the other, perhaps the economy will be confined to local situations and particular circumstances.

The clay soils, it may be estimated, produce from 20 to 32 bushels of wheat per acre,; therefore, on the average, those soils grow 26 bushels per acre, taking that quantity as the medium for a number of years; but the land must be of a better quality than I have fixed upon for my calculation, if it produces 27 bushels per acre. If I assume that wheat brings 60s. per quarter, and the other produce of the farm sells at proportionate prices, and that the parish rates, &c. amount to four shillings in the pound, this land cultivated on the foregoing system, leaves a clear rent of 23s. 10½*d.* per acre only. But it must be here observed, there is no drawback allowed for manure; and consequently, if any be purchased, the cost must be taken out of the profits of the occupier, as the rents of land of this quality, are generally higher than 27s. per acre. It may be said, there are other ways more profitable to the occupier, to which land of this description may be applied; but of the various methods now in practice, there are many of them worse than that to which I have adopted.

The universal custom formerly, particularly in open fields, was to make a fallow on the clay lands every third year, and this ruinous system is still continued in some parts, on the worst clays. One reason given for this practice is, that the land is so glutinous in a moist state, and so hard and stubborn when it is dry, that it is impossible to work it for a Lent crop, or to convert it into clover or grass. One of the principal obligations in leases or agreements, has been to

compel the tenant to make a fallow for every third crop, under the idea that such a process was necessary to cleanse the land of the seeds of noxious weeds and other pelf. Some persons are of opinion also, that frequent ploughings in the summer enrich the soil; but I trust I shall be able, in the succeeding pages of this work, to demonstrate satisfactorily, the defects of this system, and therefore, I shall not at present make any further remarks upon the subject.

The barley-soils, as they may be termed, vary as much in their produce as any other description of land. The stony, that is, gravelly and flinty soils, generally grow the finest quality of corn; and the deep mixed soils, or loams, produce the greatest quantity. The sands when forced by manure, will throw up an abundance of straw; but the grain will be deficient in quantity, when compared with the other crops, and not unfrequently light and of an inferior quality. The produce may be estimated from three to six quarters per acre; but where the average quantity is five quarters per acre, the land may be considered to be of the best quality. We hear, sometimes, of six and seven quarters per acre having been grown; but this quantity must have been confined to a small breadth of land, and have depended, in a great measure, upon some particular season. The system, in the Second Class, may be said to be the general customary system adopted on this kind of soils. Then according to that system, and taking the average price of wheat at 60s. per quarter, and the parish rates, &c. at four shil-

lings in the pound, this land leaves a rent of 25s. 4d. per acre.

The light soils, by different farmers, are applied in various ways. Some attempt to grow clover every fourth or fifth, and others only every sixth year: the latter, certainly, is an improvement upon the two former systems, as it gives the cultivator an oppor-

CLASS II.

FIFTY ACRES OF TURNIP & BARLEY SOIL.

OUTGOINGS—*when managed in the customary way.*

	£.	s.	d.
Tillage for wheat, 18s. per acre, seed and sowing, 23s. 6d., reaping and harvesting, 16s. 6d., thrashing, &c. 22s. 6d. per acre,	40	5	0
Tillage for turnips equal to 5 ploughings, at 60s. mixing, carting and spreading dung from two crops of straw, 12s. per acre, purchasing and carting one-third of a manuring, 33s. 4d. per acre, seed, sowing and hoeing, 14s. per acre,	59	13	4
Tillage for barley, 36s. per acre, seed and sowing 16s. weeding and harvesting, 12s. 6d. taking in, thrashing and marketing, 20s.	42	5	0
Clover and grass seeds, sowing, &c. 10s. 6d. per acre,	5	5	0
Shepherding, repairs to fences, drains, &c., car- penter, mason, materials to staddles, hurdles, small implements, &c. 6s. 6d., highway and parish taxes, 5s. per acre, or 4s. in the pound	28	15	0
Occupier, 5 per cent. on his capital, 8s. 6d., super- intendence 7s. and housekeeping 15s. per acre	76	5	0
	£ 252	8	4

tunity of growing a greater breadth of stubble-turnips, vetches, or rye, for spring eating, a plan, whenever it can be carried into practice, that never ought to be neglected. I shall however, defer any further comments upon this head, until I have drawn out a comparative system on a longer rotation of crops.

CLASS II.

PRODUCE—*when cultivated in the customary way,*

A.	R.	P.		£.	s.	d.
10	0	0	Wheat, 27 bushels per acre, at 60s.			
			per quarter,	101	5	0
10	0	0	Turnips, 10 sheep per acre, 20 weeks,			
			improve 10s. each,	50	0	0
10	0	0	Barley, 5 quarter per acre, at 32s.			
			per quarter,	80	0	0
10	0	0	Clover and grass, 4 sheep per acre,			
			26 weeks, improve 16s. 6d. each,			
			1 wintered, improves 8s.....	37	0	0
10	0	0	Second seeds, 3 sheep per acre, 26			
			weeks, improve in wool and car-			
			cass, 15s. each,	22	10	0
	20		acres of straw, pigs and poultry,			
			25s. per acre,	25	0	0
Total produce,....				315	15	0
Ditto outgoings, ..				252	8	4
Rent or profit,.....				£63	6	8
Per acre,..				£1	5	4

OUTGOINGS.

One Hundred and Forty Acres of good Grass Land,

CLASS III.

£. s. d.

Dairy maid and boy's wages and board, vessels, fuel, &c. 30s. each cow, decrease in value and cowleech, 20s. each. wintering at hay and straw, £5. each, parish rates, 8s. per acre, repairs to fences, drains, materials, &c. 6s. 6d. ditto, occupier's interest, super- intendence and housekeeping, £64. 10s. or 15 and 1-20th per cent. on £410,	243	10	0
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CLASS IV.

Parish rates, &c. and repairs, as above, £29, oc- cupier's interest, £16. 16s. superintending 7s. per acre, and housekeeping, 15s. per do. or 18 and 1-20th per cent. on £336,	89	16	0
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CLASS V.

Parish rates, &c. and repairs as in last, £29., occupier as ditto, or $31\frac{1}{2}$ per cent. on £195.	82	15	0
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CLASS VI.

Repairs, 2s. 6d. per acre, rates, &c., 8s. mowing and harvesting 31 ton of hay, 7s. 6d. per ton, superintendence and housekeeping, 25s. per acre, manure, 30s. ditto,	77	2	6
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CLASS VII.

Annual expenses as above, viz. 10s. 6d. per acre, mowing and harvesting, 7s. 6d. per ton, occupier's interest, 25s. per acre,	47	2	6
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PRODUCE.

applied as under, with 20 Acres of Water Meadow.

CLASS III.

ACRES	£.	s.	d.	£.	s.	d.
40 Dairy, 20 cows, 3 ton 15 cwt. of 56s. per cwt., calves, whey and whey butter, £3. 10s. each cow, 10 sheep summered, improve in wool and mutton, 20s. each, 40 wintered, ditto, 8s. 6d. each,	307	0	0			
Outgoings,	243	10	0			
	<hr/>			63	10	0

CLASS IV.

40 Feeding, 23 heifers (cost 12l. each) improved for summering, 5l. 7s. 6d. each, 10 sheep sum- mered & 40 wintered as above,	150	12	6			
Outgoings,	89	16				
	<hr/>			60	16	6

CLASS V.

40 Store, 10 heifers (cost 9l. each,) improved 4l. each, 70 ewes im- proved in wool and lamb, 25s. each, 40 ditto wintered, im- proved 8s. 6d. each,	144	10	0			
Outgoings,	82	15	0			
	<hr/>			61	15	0

CLASS VI.

20 Meadow, (upland) 3l cwt. per acre, at 3l. per ton, aftermath, 15s. 6d. per acre,	108	10	0			
Outgoings,	77	2	6			
	<hr/>			31	7	6

CLASS VII.

20 Meadow, (water or float) 3l cwt. per acre, at 58s. per ton, after- math, 10s. 6d. per acre,	105	8	0			
Outgoings,	47	2	6			
	<hr/>			58	5	6
	<hr/>			£ 275	14	6

Or taking rates and taxes, at 4s. in the pound, leaves a rent
or profit of 36s. per acre.

These 140 acres are intended to represent a good second rate land. Pastures, like land in tillage, are applied in various ways ; although dairying, under good management, and where the land is eligible, and the farm conveniently situated, it is considered, will return the greatest profit. Cheese of the best quality, at 6*d.* per lb. which is more than equal to butter at 12*d.* is not, by common estimation, equal to meat at 6*d.* per lb.

Milk varies, both in quality and quantity, according to the constitution of the animal and the herbage upon which the stock is depastured, and these pastures always depend, more or less, upon the seasons. Supposing a dairy of cows, on the average of 39 weeks, give nine quarts of milk each per day ; and assuming also, that one hundred weight of cheese requires 163 gallons of milk, a cow would produce 3 cwt. and 3 qrs. of cheese, in the season.

Dairy and feeding stock, require more land to pasture on, than the same number of mixed store stock, and often, more particularly after a luxuriant season, leave a deal of sour coarse grass until the autumn. Every good grazier is desirous, for the benefit of his land, of having this grass closely eaten up, and he cannot accomplish that object with the same stock, unless he force them to continue on the land longer than it will supply them with a sufficient quantity of better food, and so compel them, by hunger, to eat the coarse grass ; and if he adopt this method, he does so well knowing that he shall sustain a certain injury, by im-

peding the growth of his stock, or by lessening their quantity of milk. But if the owner will be at the trifling expense of sprinkling the tufts of sour grass with a salt brine, or pure salt if the weather be showery, he will find that his stock will not only devour them greedily, but will even thrive better upon them than they had previously done upon the pasture.

Mowing the crop, and carrying it off, is not more injurious to the land, than leaving the grass upon it to decay. Such land requires a dressing of good dung every third year, or a light compost dressing for every crop of grass so taken off.

A floated or watered meadow, is an important acquisition to a farm, although its value materially depends on the fertilizing quality of the water, in artificial floating, that can be passed over it. In valuing a meadow that is floated naturally from a river or stream, care should be taken to calculate, upon an average, how often the crop may be injured by the flood in a certain number of years. The advantage may be estimated, in a successful season, from twenty to thirty shillings per acre.

OUTGOINGS.

SEVENTY ACRES OF POOR GRASS

CLASS VIII.—CASE I.

	£.	s.	d.
Parish rates, &c. 2s. 6d., repairs to fences,			
drains, &c. carpenter, materials, &c. 6s. 6d.			
per acre—Capital employed, 309l. 15s. 0d.			
interest, 15l. 9s. 9d., superintendence, 7s.,			
housekeeping, 15s. per acre,	123	19	9

The above 70 acres of land, are intended to represent a stubborn clay; a sort of land which we see, more or less, in different parts of the country, by its having the appearance of having formerly been in a state of tillage, but now overrun with ant-banks, rushes, &c. Some years ago, we frequently heard of great losses being sustained on these pastures, by rotting the sheep. But this kind of land has been greatly improved within these forty years by draining, and the rushes having in part disappeared, the whole has become more healthy. Although this land makes but very little profit in grass, it would make still less under the customary mode of cultivation, in plough. Indeed wheat, off naked fallows, must average 66s. or 70s. per quarter, before the worst clays, under the fallow system, could produce any rent; and it is the opinion of the best informed men in the market, as well as the most enlightened agriculturists, that wheat will not average 60s. a quarter under the corn laws. If this opinion be founded in fact, then it becomes evident, that these pastures, instead of being converted into

PRODUCE.

LAND, APPLIED TO STORE STOCK.

CLASS VIII.—CASE I.

A.	R.	P.		£.	s.	d.
70	0	0	Eighteen heifers improve in summer-			
			ing, from 7 <i>l.</i> to 10 <i>l.</i> each, 105			
			ewes ditto in lamb and wool, 20 <i>s.</i>			
			and 35 wintered improve 5 <i>s.</i> each,	167	15	0
			Outgoings,	123	19	9
				<hr/>		
Rent or profit,				£ 43	15	3
Per acre,					0	12 6

tillage to meet the demands of an increased and increasing population, and supplying our scantily employed labourers with an additional means of subsistence, must be kept in pasture; and that all such land, now in plough, must go to grass, unless some more economical or advantageous mode of cultivating them can be adopted. The British farmer indeed is now so situated, that he has no alternative to save himself from ruin, than by pursuing a more systematic, and a better system of cultivation than the one adopted by the Foreigner.

I am aware that some persons will contend that the price of grain will not bear an extra expenditure. The political economist will go still farther, and say, that profits arise from capital, and experience teaches us that reward is the stimulus to industry. These positions would be incontrovertibly true, did they not fail in one most essential point, which is, that that capital, the experience, and that industry, must be employed where the grand object sought after, namely, *profits CAN be obtained*; otherwise the capital is

diminished, and the experience and industry, however valuable when united on most other occasions, are here employed in vain.

Nevertheless, if improvements are to be made, it is likewise as evident that they must be effected by skill and economy combined.

OUTGOINGS.

SEVENTY ACRES SAME AS LAST,

CLASS VIII.—CASE II.

	£.	s.	d.
Ploughing, 16s. seed, &c. 23s. 6d. dibbling and hoeing in, 12s. 6d., harvesting, &c. 16s. 6d. per acre, taking in, thrashing, &c. and carting to market, 10d. per bushel,.....	38	14	4½
Mixing, carting & spreading dung from 2 crops of straw, 12s. ploughing, 16s. seed, 16s. 6d. planting, hoeing & soiling, 12s. 6d. $\frac{1}{4}$ acre,	24	18	9
Tillage equal to four ploughings, 64s., seed, 23s. 6d., reaping and harvesting, 16s. 6d., thrashing, &c. 20s. per acre,.....	54	5	0
Ploughing, 16s. seed, 16s. planting and hoeing in, 12s. 6d. moulding, 5s. 6d. hacking, harvesting, &c. 16s. taking in, thrashing, &c. 18s. per acre,	36	15	0
Ploughing, 16s., seed, preparing, &c. 23s. 6d., dibbling and hoeing in, 12s. 6d., reaping, harvesting, &c. 16s. 6d., taking in, thrashing and marketing, 20s. per acre,.....	38	14	4½
Mixing and carting dung from 2 crops of straw, 12s., other tillage as before for vetches, ..	24	18	9
Tillage, equal to five ploughings, 80s., seed and sowing, 16s., mowing and harvesting, 12s. 6d., thrashing, &c. 18s. per acre,.....	55	6	10½
Clover seed, 14lb. or 10s. 6d. per acre, mowing and harvesting, 22 ton 6 cwt. 1 qr. at 7s. 6d. per ton, carting dung, spreading, &c. from two crops of straw, 12s., adventitious manure, 70s. per acre,	48	16	8
Poor's tax, highway duty, annual expenses and occupier's interest, as in Class 8, page 92,	123	19	9
	£446	9	6½

Now let us see what improvements can be made in Class 8, by comparing them with the more customary modes. Old pastures, capable of supporting stock equal to five ewes and lambs to two acres through the summer, must be considered as land that will grow 24 bushels of wheat, or 27 bushels of beans per acre.

PRODUCE.

ON THE IMPROVED METHOD.

CLASS VIII.—CASE II.

A.	R.	P.		£.	s.	d.
8	3	0	Wheat, 24 bushels per acre, at 60s.			
			per quarter,	78	15	0
8	3	0	Vetches, 90s. per acre,	39	7	6
8	3	0	Wheat, as above,	78	15	0
8	3	0	Beans, 27 bushels per acre, at 44s.			
			per quarter,	64	19	4½
8	3	0	Wheat, as above,	78	15	0
8	3	0	Vetches, as above,	39	7	6
8	3	0	Barley, 4½ quarters per acre, at 32s.			
			per quarter, or 6 quarter of oats,			
			at 24s. ditto,	63	0	0
8	3	0	Clover, first crop, 35 cwt. second ditto,			
			16 cwt. per acre, at 65s. per ton,	72	10	3
			Straw, pigs, and poultry, from 43A.			
			3R. 0P. of crop, at 20s. per acre,	43	15	0
Total produce,				559	4	8½
Ditto outgoings, ..				446	9	6½
Rent or profit,				£ 112	15	2
Per acre, ..				£ 1	12	2½

OUTGOINGS.

SEVENTY ACRES SAME AS LAST

CLASS VIII.—CASE III.

	£.	s.	d.
Ploughing, 16s. seed, 16s. harrowing and planting, 12s. 6d. hoeing twice, 12s. harvesting, 16s. thrashing, 18s. per acre,	105	11	5
Tillage, equal to five ploughings, 80s., mixing, carting and spreading dung, 12s. per acre, ..	107	6	5½
Seed, &c. 23s. 6d., ploughing in, dressing, water furrow, &c. 16s., weeding and harvesting, 16s. 6d., taking in and thrashing, 20s. per acre,	88	13	2
Annual expenses, as in the foregoing tables, ..	123	19	9
	£425	10	9½

The object I have in view, in the Comparative System, Class 8, page 92, is to shew the advantages to be derived from abrogating summer fallows. It may still be the opinion of some persons that fallows cannot be dispensed with on all kinds of land, but we know, by experience, that the practice has been gradually on the decline, on the more mixed soils, for the last forty years; and, I do not hesitate to affirm, that, if it were not for the injudicious and misadvised covenants in leases and agreements, such an unprofitable, wasteful, unnecessary practice, would be very short lived. The difference in the profits, between the alternate cropping and the fallow system, is upwards of 30s. per acre, independently of many other great advantages, which I shall point out hereafter. By reckoning wheat at

PRODUCE.
ON THE COMMON METHOD.

CLASS VIII.—CASE III.

A.	R.	P.		£.	s.	d.
23	1	13	Beans, 27 bushels per acre, at 44s.			
			per quarter,	172	0	10½
23	1	13	Fallow,	0	0	0
23	1	13	Wheat, 24 bushels per acre, at 60s.			
			per quarter,	209	19	7½
			Straw from 46A. 2R. 26P. pigs and			
			poultry,	46	13	3
Total produce,				428	13	9
Ditto outgoings, ..				425	10	9½
Rent or profit,				£3	2	11½
Per acre, ..				0	1	2

60s. per quarter, and meat at 6d. per pound, more than 20s. per acre can be made of the land in tillage than when kept in pasture.

I am well persuaded that some persons will say, that the system I propose is not practical on stubborn glutinous clays, which cannot be ploughed in dry weather. They, who make such observations, I conceive, have not considered, maturely and impartially, the friability and fertility imparted to such soils, by meliorating and smothering crops, in succession.

This system is encouraged now by many other great advantages which had not been brought into practice when those lands were in tillage. The improvement in ploughs, and other effective implements, which have been invented since that time and are now

in use among agriculturists, have furnished the farmer with easier and better means of contending with and overcoming the difficulties which the cultivation of such land formerly presented to him. The use and of course the value, of meliorating crops, was then but little understood. All these things, therefore, combined, tend greatly to facilitate the practicability of a successful change in the system of management and cropping of the land.

Some readers may probably conclude, that when I before stated that 26s. per acre more could be made on poor land by the improved system, than when managed in the usual and common way, I have taken too great a latitude and fixed the sum rather too high; but examples are to be found that will support me in making that assertion.

It is pretty generally understood, that land will not produce a full crop of red clover oftener than once in eight years; if planted every fourth year, only half a crop, and so on in proportion. The fact is also well known, that fresh broken up land from old sward grows stronger plants of red clover than the same kind of soil produces where that plant has been oftener grown; and it has also been remarked, that the land that has been constantly ploughed and cropped with grain, grows the strongest and most luxuriant crops of red clover; and that the plant holds a greater length of time in the land than when the same kind of soil has been longer in grass. The cause of this will be explained in another part of this work. Some have

even gone so far as to estimate a luxuriant crop of red clover, when cut twice in its highest state of mucilage for soiling, as high as 20 tons per acre ; but as I wish to avoid an extreme, I will take the first crop at ten and the second at five tons per acre, when its succulent properties give it the greatest weight. I calculate vetches to weigh ten tons per acre, which is a very moderate estimation, something less than 5lbs. per square yard, and 140lbs. only to the pole. These three crops of green food, then produce 306 tons 5 cwt. being nearly as much food in weight, as the whole 70 acres produce in grass. Vetches and clover, it has been remarked, mowed green and carted in that state to the stock in the fold-yard or in sheds, go much farther than when eaten on the land ; and by consuming those crops in this way, the animals deposit on one spot, an abundance of rich manure. This kind of land is, perhaps the most difficult of any, to convert into grass from tillage ; and it cannot excite any surprise that so much of it was suffered to go into grass, when we consider the little profit it returned under the customary mode of fallowing.

There are many persons, even at the present day, who contend that summer fallows are necessary to rest the land—others say that it cannot be kept free of root-grass and weeds without the aid of summer fallows—while others believe, that by exposing it frequently to the atmosphere, by repeated ploughings, the land is mellowed and enriched. But if we lay aside prejudice, and examine these opinions by the test of expe-

rience, we shall find by the result, that all these reasonings are fallacious.

I should be ashamed to say a single word to the enlightened Agriculturist, in refutation of the first opinion, of the land wanting rest ; as he well knows that the earth is destined by nature, to an everlasting round of vegetation, and wants nothing more than to be judiciously planted, and to have her own productions returned to her, to keep her in a perpetual state of productiveness. The dung-fork must be also used to take out the tufts of couch-grass from the corn stubbles, when it is prevented from accumulating in the former part of a rotation, it prevents a multiplicity of both horse and hand labour in the after tillage.

Twitch-grass becomes predominant through improper management ; and it would, perhaps, only be a waste of seed, labour and time, to plant such land, until it had been winter and spring fallowed ; and if they are succeeded by good tillage and proper cropping, it will in time become perfectly clean.

As to the numerous tribe of noxious weeds, we know they were yet more numerous before the drilling and hoe systems were brought into such general use. We have a further evidence of this fact, on those farms where the hoe is neglected ; and where (although they make good summer fallows as they call them,) the crops are often smothered with charlock and other weeds ; so that it is quite evident that the credit of a clean farm, is in part due to the hoe. The best way to destroy these shy enemies is to bring them fairly

into the field ; and then if we compare vetch and winter fallowing, with summer fallowing, we shall find that the latter season is much more likely to encourage their growth and promote their vegetation, than the former.

It is a folly to suppose that the surface soils are much enriched by repeated exposures to the influence of a scorching sun ; for though the falls from the atmosphere bring with them enriching properties, a part of them are again inhaled by the power of the solar rays, and more so from a naked surface, than from land that is covered with a crop. Indeed both the stalks and leaves of plants are more attractive, as well as absorbent, and the fall from the leaves more decomposing by their shady powers, than on a bare surface.

We know that earth, heat, air, and water, are the natural elements for plants, and some may suppose that these elements may become more saturated by repeated stirrings ; but there is no more fertility obtained by it, though it be necessary to reduce the soil to a fine tilth for all small seeds. But larger plants, barley excepted, produce the best crops and the finest samples, on a firm furrow, planted, drilled or harrowed in ; and there is a greater certainty of an abundant produce after a smothering, shady crop, than after a summer fallow.

I should, however, further observe, that middling old grass land seldom carries stock sufficient to cause a gradual, or progressive improvement ; and where such lands have been much improved, it has been by

costly draining and manurings. In the more expensive method of two crops and a fallow, I do not know of an instance of such land having been improved, except by a further cost in manuring. But in the system, Case 2, such a course of cropping is laid down, that is calculated to keep land in condition, by its own produce, and it would not cost any thing in manure, when it had been once put into condition, if it was judiciously tilled, and the dung properly managed.

OUTGOINGS.

Eighty Acres of good Wheat and Bean Soil, the

CLASS I.—CASE II.

	£.	s.	d.
Tillage, 21s., seed, preparing and planting, 23s. 6d. reaping and harvesting, 16s. 6d. taking in, thrashing & marketing, 22s. 6d. $\frac{1}{4}$ acre,	41	15	0
Tillage, 21s., seed and drilling, 18s., soiling, 5s. preparing and carting dung from two crops of straw, 12s. per acre,	28	0	0
Tillage, equal to five ploughings, 70s. seed, &c. 16s. harvesting, 12s. 6d., taking in, thrashing and marketing, 20s. per acre,	59	5	0
Tillage, 21s. seed, 16s. 6d. planting and hoeing, 16s., harvesting, 16s., taking in, thrashing, and carting to market, 15s. mixing and carting dung from 2 crops of straw, 12s. $\frac{1}{4}$ acre,	48	5	0
Tillage, &c. as before,	41	15	0
Tillage, &c. ditto,	28	0	0
Tillage, &c. ditto,	59	5	0
Clover seed, 7s. 6d. per acre, harvesting 30 tons of clover hay, at 7s. 6d. per ton, bought manure, &c. 70s. per acre,	50	0	0
Annual expenses & occupier's interest, the same as in Class 1—Case 1, page 82,	169	6	8
	<hr/>		
	£	525	11 8

In the comparison of the three systems, under Case 1, seventy acres of grass make a net profit of £43. 15s. 3d.—In Case 3, seventy acres when ploughed and worked in the old customary method, leaves a profit of £3. 2s. 11½d. only. But in Case 2, the seventy acres worked on an improving system, and with an annual expense for manure, of £30. 12s. 6d., which would be necessary, perhaps, only where land was out of condition, leave a net profit of £112. 15s. 2d.

PRODUCE.

same as Class I, (page 83,) on the Improved Method.

CLASS I.—CASE II.

A.	R.	P.		£.	s.	d.
10	0	0	Wheat, 27 bushels per acre, at 60s.			
			per quarter,	101	5	0
10	0	0	Vetches, £5. 5s. per acre,.....	52	10	0
10	0	0	Barley, 5 quarters per acre, at 32s.			
			per quarter,	80	0	0
10	0	0	Beans, 30 bushels per acre, at 44s.			
			per quarter,	82	10	0
10	0	0	Wheat, as above,	101	5	0
10	0	0	Vetches, ditto,.....	52	10	0
10	0	0	Barley, ditto,.....	80	0	0
10	0	0	Clover, mowed twice, 3 tons per acre,			
			at 63s. per ton,.....	94	10	0
			50 acres of straw, pigs, and poultry,			
			at 25s. per acre,	52	10	0
Total produce,				697	0	0
Ditto outgoings, ..				525	11	8
Rent or profit,				£ 171	8	4
Per acre, ..				£ 2	2	10
Extra expenditure in manure, £35				0	0	

In comparing the two systems of Class 1, we find on the 80 acres a difference in profit of nearly £73.; and there are also, in the latter system, other advantages of no small magnitude. In the first place, the growing of green crops as a substitute for summer fallows, is more improving to the land, and perhaps the £35. extra allowed for manure in the latter system, might be dispensed with after the first round of cropping; besides other green crops may be taken after the vetches are soiled off, such as a second crop of vetches, or rape.

I have before observed, if a traveller's horse is to perform his journies well, he must first be put into condition at starting and be properly nursed on the road; and then he returns at the end of the year, in a state fit to set out on a second round of journies; and besides, his load may either be increased or diminished in weight, in proportion to his powers. If this land be powerful and clean, beans may be grown the second crop. If it be weak, or out of condition, vetches should form three of the green crops, and clover the fourth. But it must still be kept in memory that the dung should be applied to the green crops.

In this place, I think it right to observe, that when the clover begins to leave the ground, the twich-grass begins to thrive; and when the clover has wholly disappeared, that troublesome weed rapidly accumulates; and it is an important fact, that the agriculturist should never lose sight of, that it is

in the roots of the twitch-grass that the wire-worm deposits her eggs, and where that destructive little animal is propagated, nourished, and brought to maturity ; but we never hear of this worm on land where a close and good system of tillage is pursued.

If I should be here asked where the sheep are to be kept ? my reply is, that question has been already answered, where I have stated that a greater weight of food is derived from the green crops, than the whole eighty acres would produce in grass. Besides, I would strongly recommend, on this description of soil, the growing of cabbage and vegetable roots, for winter and spring eating. This sort of land carries but little stock, for some years after the seeds are gone, so that a little additional old pasture would supply the place of old grass land ; but this subject will be more fully discussed hereafter.

OUTGOINGS.

Fifty Acres of good Turnip and Barley Soil,

CLASS II.—CASE II.

	£.	s.	d.
Tillage, 18s., seed, &c. and drilling, 23s. 6d., reaping, harvesting, &c. 16s. 6d., taking in, thrashing, &c. 22s. 6d. per acre, tillage for turnips, seed and sowing, 19s. per acre, ..	31	1	10½
Making fallow, 60s., mixing dung made from two crops of straw, carting, &c. 12s. seed, sowing and hoeing, 14s. per acre,	26	17	6
Tillage, equal to three ploughings, 36s., seed and drilling, 16s. harvesting, 12s. 6d., thrashing, &c. 20s., tillage for turnips, sowing, &c. 19s. per acre,	32	6	10½
Tillage, 36s., mixing and carting dung, 12s., seed and drilling, 18s., hoeing and mould- ing, 10s 6d., harvesting, 12s., thrashing, 12s., tilling, &c. for turnips, 19s. per acre,	37	6	10½
Tillage, &c. for barley alone,	26	8	10½
Tillage, 18s., seed and sowing, 18s., carting dung, 12s., soiling, 5s., tillage for turnips, 36., seed, drilling and hoeing, 10s. 6d.,....	31	1	10½
Tillage, 36s. seed, &c. as before,	26	8	1½
Clover seed, 7s. 6d., bought manure, £3. 10s. per acre, mowing and harvesting 16 tons 5 cwt. at 7s. 6d. per ton,	30	6	3
Annual expenses and occupier's interest the same as in Class 2, page 86,	105	0	0
	<hr/> £ 346 18 3 <hr/>		

Since the first edition of this work was published, this system has been practiced on the best turnip soils and proved highly advantageous, both in adding fertility to the farm and rendering it cleaner for a suc-

PRODUCE.

cultivated as under, or on the Improved Method.

CLASS II.—CASE II.

A.	R.	P.		£.	s.	d.
6	1	0	Wheat, 27 bushels per acre, at 60s. per quarter, rye or stubble-tur- nips, 33s. per acre,	73	14	4½
6	1	0	Fallow-turnips, Swedes, £5. per acre,	31	5	0
6	1	0	Barley, 5 quarters per acre, at 32s. per quarter, stubble turnips, 33s. per acre,...	60	6	3
6	1	0	Pease, 3½ quarters per acre, at 48s. ¼ quarter, turnips, 35s. ¼ acre,	65	12	6
6	1	0	Barley, alone,.....	50	0	0
6	1	0	Vetches, £5. 5s., brush-turnips, £3. 10s. per acre,.....	54	13	9
6	1	0	Barley, as above,	50	0	0
6	1	0	Clover, mowed twice, 52 cwt. per acre, at 65s. per ton,	52	19	3
			Straw, pigs and poultry, from 31A. 1R. 0P. at 25s. per acre,	39	1	3
Total produce,				477	12	4½
Ditto outgoings, ..				342	12	6
Rent or profit,.....				£ 124	19	10½
Per acre, ..				2	9	5¾
Extra expenditure in manure, ..				5	4	2

ceeding rotation, and where the tufts of couch grass have been taken out of the corn stubbles, a single ploughing for each crop, has, in most cases, been found sufficient.

CHAP. IX.

THE ADVANTAGES OF THE IMPROVED SYSTEM POINTED OUT—THE TWO SYSTEMS COMPARED AND THE DIFFERENCE STATED—SUMMER FALLOWING WILL NOT DESTROY THE SEEDS OF WEEDS—ROTATION OF CROPS—ON VETCH-HAY, &c. &c.

It is almost needless again to make any further comment on the advantages arising from close cropping, as every experienced farmer knows that his land is enriched in proportion to the quantity of animal dung he raises on his farm. Or, in other words, the greater the bulk of roots and other vegetables that he consumes with his stock on his farm, the greater is the improvement made in the soil.

There cannot be a doubt that land improves by laying in grass, as its entire produce is returned to it in the form of manure at the time it is taken off, which is a certain advantage. It has also the faculty, by the attractive powers of its surface covering, to receive, and to retain, a great portion of the nutritive and fattening qualities of those elements that fall from the atmosphere. While there are modes that will, by

meliorating the land, facilitate vegetation, and produce more profit to the cultivator, than those hitherto in use, surely the old customs should now be discarded. Indeed, public necessity points out that some alterations should take place, as the present mode is not producing corn enough for the population. If it be the obligations in leases that obstruct a better mode, then they ought to be expunged, and the alterations I have pointed out, combined with economy, should be speedily adopted. I see no reason why the same annual expenditure for manure should not be bestowed on Case 1, as on Case 2, (page 106,) but that the profits will not afford it; but this, in truth, is saving the penny to lose the pound; and if land afford any profit to the occupier, he must first of all put it into good heart and condition, and continue, ever afterwards, to keep it so.

The favourite practice of some of our best agriculturists, has been to cultivate this sort of land on a four-round course, viz.—wheat, barley, turnips, and seeds; and this has been found to be an excellent way to keep the land clean, and the system would have been profitable also, if they could have grown clover, but the loss of that crop, or at least half a crop, every fourth year, is a matter of serious consequence, and renders a change of system necessary. They who have been accustomed to grow wheat on this sort of land every fourth year, would perhaps depart from such a custom with some reluctance, under the idea that by doing so, they would sacrifice some profit;

but the consideration of a moment will convince any one, who is of this opinion, of his error; and if the eight-round course here laid down, be not sufficiently clear, let him take the trouble of making his own calculations, and he will be speedily satisfied that the plan I have recommended, is not only the most eligible, but the most profitable. If then he bring home conviction to his mind, let me remind him of the old adage, which says, the better way of doing a thing is always the best.

Light land, whether it be sandy gravel, or sandy loam, is more suitable for barley than for wheat, and exhausts the land less; and wheat, on this sort of land, succeeds best on a clover or grass ley; and here, he who will not depart from his old custom, may still adhere to his favourite four-round system. The method which has stood the test of experience, is always entitled to our notice and consideration, and if vetches be substituted for pease, as the fourth crop from clover, drilled or sown the last week in September, and if about six pecks of ryegrass, or 10 lbs. of trefoil, or some other cheap grass, be sown at the same time, he will then have his favourite ley to plant his wheat on at Michaelmas, as well as have a good pasture for his sheep, from the time he soils off his vetches; but I must observe, that this system is practicable only on the mode here laid down. The land should always be manured and freed from twitch-grass, at the time of sowing the green crops, for here lies the merit; it is either the best or the worst husbandry in practice.

Some twenty years ago, I recollect a person advertising in the public journals, that he had discovered the grand secret of growing ten bushels of wheat per acre, on all descriptions of soils, more than could be produced by the common method, which was an object of great importance at that time, as it is at all times; and this plan professed, like all other plans of quackery, to protect the crop against all diseases. The secret was to be disclosed to any one on his paying five guineas. The grand secret was, to make a good winter and summer fallow, finished off by Midsummer; then to sow fifteen pounds of trefoil seed per acre, the crop to be grazed off by sheep, and the land to be sown with wheat at Michaelmas; the certificates for obtaining a knowledge of this secret, soon fell in price. I own there was some little merit due to the discoverer of this project, and I have no doubt but the hint may be useful to those who still adhere to the fallow system in the old beaten track, particularly on light land.

I will now bring forward the net produce of the farm of 360 acres, and draw the comparison between the Common Mode and the Improved System.

On the Customary Mode.

A.	R.	P.		£.	s.	d.
80	0	0	of good wheat and bean land,	99	8	4
50	0	0	of good turnip and barley ditto, ..	63	6	8
160	0	0	of good grass and meadow,	275	14	6
70	0	0	of poor clay (grass) cultivated, ...	43	15	3
<hr/>				<hr/>		
360	0	0		£	482	4 9

Being £205. 18s. 1½*d.* in favour of the improved method, independent of £86. expended in manure on the 200 acres of tillage.

It is needless to comment further on the advantages to be obtained by the system here recommended ; for if the reader will take the trouble to compare the two cases with each other, he will find that the second case embraces every thing that is desirable to constitute good and profitable farming.

I have made some observations on summer fallows, in a former part of this work. All the benefits that can possibly arise from them, are to free the land of noxious seeds and roots, and that object can be more perfectly and more economically obtained, by autumn and the succeeding spring tillage, and particularly so after vetches, and after two courses of this plant, followed by barley or oats. Let the land be ever so badly saturated with the seeds of large or dwarf weeds, if it be ploughed sufficiently deep, the whole of them will be exposed to the influence of the atmosphere. It should be understood, that these seeds, after being locked up in the clods, do not vege-

On the Improving System.

A.	R.	P.		£.	s.	d.
80	0	0	as before,	171	8	4
50	0	0	ditto,	128	4	10½
160	0	0	ditto,	275	14	6
70	0	0	ditto,	112	15	2
<hr/>				<hr/>		
360	0	0		£688	2	10½

tate with moisture alone; but they require more air and oxygene to cause germination; so that frequent stirrings in summer do not combine enough of this organized matter to cause them to germinate, and the land again becomes fresh seeded, and more or less of these weeds will, in spite of the drill and hoe, remain in the land. In truth, fallowing land for the purpose of extracting the weeds, instead of gaining one step towards the goal, is falling back two or three; while the former method will totally eradicate weeds of every kind and size, and leave the operation of the hoe for that purpose, nearly useless.

In the preceding observations, as I have alluded more particularly to the heavy soils, I shall now say something of the light or turnip land. I shall, however, first remark, that when land of any description is tolerably well cleared of pelf, any other green crop, as the second and fourth, may be introduced, such as cabbage, beans or pease; but vetches should never be omitted as the sixth, for in that crop is the preparation for clover, and I may say, of barley also, for that grain grows always stronger in straw, and finer in sample, on any land after vetches, than after turnips.

A question may here arise in the minds of some readers, how are the sheep to be kept without young grass pastures? To this I answer, that there is insured, in the first place, a great crop of aftermath clover, more than equal to a year's pasturage on second or third seeds. And also, that there are extra crops of rye, stubble-turnips, or winter barley and vetches, for spring eating; and I have before shewn, that there is a greater weight of food for cattle, on three-eighths of the land, than the whole farm would produce if in grass, besides Swedes should be plentifully stored, so as to have a sufficient supply in case of a backward spring.

I am not unconscious that another difficulty may here present itself, as to the manner in which this description of food is to be distributed throughout the season. The farmer, I am assured, would find his advantage in growing *vetch-hay*, the real value of which is not sufficiently known. From the mucilaginous quality of this plant, it may perhaps be supposed that it is not easily made into hay, or that the hazard of getting the crop in good order would be too great. There is more hazard, certainly, in harvesting both clover and vetches, than there is in getting the proper grasses, or rye-grass; but the clover and vetch crops should be made by a different process. If either of these crops be mowed when the weather is tolerably settled, they soon become sufficiently withered so as to be put into cock. The first cocks should be of a small size, but yet large enough to put the whole into a state of fermentation. The next day the cocks

should be shifted, and made a little larger ; and so on until the mucilage has nearly escaped. When this has been done, a few hours of sun and wind will make the crop ready for the rick. The cocks should be neatly made, and lightly put together ; and one of the first of them should be drawn straight to serve as a cap during the process. If vetch-hay is properly attended to, there is but little more hazard in preparing it for the rick, than there is in preparing wheat for the barn. This hay is eaten greedily by horses or sheep, and they will do as well on it as they will on any store pasture.

One thing should not be lost sight of, which is, that the three first green crops, will require all the dung made from the eight crops, divided equally amongst them. The dung should always be used in the green state, and ploughed in immediately it is carted on the land. The clover will require a top-dressing, either of dung or compost, whichever can most conveniently be procured.

I have before observed that these systems comprise every thing that is necessary to constitute regularity and good farming. I have, it is true, spoken rather positively of having a good crop of clover. That plant, most certainly, is liable to be attacked by the fly in its early stages, or it may be injured by the frosts, if it be sown before they have subsided ; but these are unavoidable events that may be discovered before Michaelmas ; and should such an event occur, the land should be immediately dunged and sown

with vetches, to meet the disappointment in the following summer.

The slug breeds, and often accumulates in great abundance in green crops, after a moist season, but they may be prevented from doing much damage, by sowing quick-lime or salt, early in the morning or late in the evening, when this destructive animal is from its hold at feed. The rooks should be rather encouraged than driven off. There is nothing to dread from the wire-worm, as that mischievous animal is prevented from increasing by close tillage. I shall again repeat, that clover is a nursery for corn, and that farming will not arrive at perfection, until wheat follows clover, as closely as barley follows turnips, on all descriptions of soils.

CHAP. X.

ON THE BAD EFFECTS OF SOWING WHITE OR DUTCH CLOVER—WHY RED CLOVER CEASES TO VEGETATE—GYPSUM THE PECULIAR FOOD OF RED CLOVER—OBSERVATIONS ON TWO FIELDS IN THE PARISH OF ASHOW—SIR HUMPHREY DAVY ON GYPSUM, AS A TOP DRESSING FOR LAND, AND AS A MANURE FOR RED CLOVER—SOILS CONTAINING THE MOST GYPSUM GROW THE BEST CROPS OF RED CLOVER—SUCCESSFUL EXPERIMENT WITH GYPSUM ON WOODCOTE FARM.

I AM now about to enter upon a subject that will, I am well aware, expose me to reflection, if not by some to censure. But as the subject is one of great importance, I shall not only make the assertion, but support it until some one of greater experience, and of more acute observation, has convinced me that I am in error. I say that *white clover* is injurious to the growth of red clover, and is a noxious weed on all land intended to be kept in tillage, as it supplies the place of a better plant, and robs the soil of that property which would support one of a much more valu-

able description. I admit, nevertheless, that it ranks amongst the best sort, if it be not itself the very best plant in permanent pastures. The white clover is a perennial of the trefoil tribe; and very few of them, if any, produce more seed in proportion to the size of the plant, and although stock of every description will feed greedily on the leaves, they reject the stem and flower, and in all pastures where it grows, most of the seed is generally shed upon the ground, and becomes a nuisance to tillage. The seeds, like those of all other plants, which are of an oily nature, will lie dormant in the soil for years, and so far it may be useful in old pastures, by keeping up a succession of its species; but where the land has been repeatedly sown with white clover, trefoil, cow-grass, &c. the red clover will always grow weaker, and leave the ground sooner.

In botany, all clovers are classed as belonging to the trefoil tribe of grasses, and partake alike of the same vegetable powers of the soil; and every super-numerary acts as a noxious weed, in proportion to the nourishment it draws from the soil, and proves injurious to other plants. These seeds are got rid of by the means I have before recommended for the extirpation of others, and afterwards may be prevented from propagating, by the system I have already laid down.

I have before noticed that it is an excellent practice to soil off heavy crops of clover, but this will be treated of in the following pages. If white clover, trefoil and cow-grass is kept off the land, more bulk or weight of red clover may be grown by planting

only every successive eighth year, than can be grown by two seedings of mixed seeds in the same space of time. Thus, the saving of seed, on a tillage farm, would nearly pay the poor's rate, and the advantage to the public at the same time, would be immense. Although I do attribute the loss of that most valuable crop of all others, (I had almost said,) the red, to the predominance of the white clover; yet I wish to be understood, that I believe the red alone may be sown so close in succession, that it will exhaust the powers of the soil so much that it will not retain it.

Now, as I have endeavoured to show, by describing the disease, &c. the cause of the failure of this valuable plant, I shall now proceed to point out an antidote to, or a preventive of that cause. This, I am sure will not be very palatable to the growers and traders in grass seeds; but as most of the growers live on the other side of the water, I shall sympathize but little with their feelings upon the subject. It is the interest and the improvement of the British farmer, solely, that I have at heart; and although I believe that he takes as much pride in his white clover field, as a Dutchman does in his tulip-bed, I must, in the first place, beg of him to relinquish it.

Gypsum, (plaster of Paris,) is a species of earth, inherent in all soils, but abounds in some much more than others. It appears there is some peculiar property in this species of earth, necessary to support and stimulate the growth of clover where it abounds. Clovers generally grow luxuriant, and remain longer on

the land, but by frequent cropping, the clover gradually disappears. The ultimate consequence is, that the food upon which the clover principally depended for nourishment, having been extracted, the total extinction of the plant, of course follows. There are but two means within my own knowledge, by which this desirable and singular property in the soil can be removed—that is by bringing to the surface a portion of new earth, by deeper ploughing, and by dressing the land at the proper season, with a compost containing gypsum. This subject will be further treated on in the progress of this work.

I have said, the waste in grass seeds, in a tillage-parish, would nearly pay the taxes. I will now suppose that England contains 20,000 parishes, and the average of tillage land in each parish to be 1,200 acres; this quantity to be sown with grass seeds every sixth year, as follows: 10lbs. of red clover, at 8*d.* per pound; 5lbs. of white, or trefoil, at 3*s.* 6*d.* per acre; and ryegrass at 2*s.* per acre, which would amount to £125. in each parish.

I will now show what each parish would cost on the system I have laid down, which will ensure the greatest quantity of produce per annum, viz. 7lbs. of red clover, at 4*s.* 8*d.* per acre, which is a greater seeding for land fresh to clover, than any quantity that is usually put on land that has been exhausted by the other species. Thus there is a waste of seed in one year only, equal to a sum that will be sufficient to complete the Grand Tunnel under the Thames. Besides,

this compound system of seeding does a further injury to the country, because most of the seeds that are sown here are imported from abroad.

I shall next endeavour to communicate to the reader, how far my observations and opinions upon this head have been derived from other facts, and substantiated by other proofs, as far as they are applicable to the subject of which I am treating. It is within the knowledge of every one who has had any experience in agricultural affairs, that it is a common thing to see partial failures in clover crops. In some places there will be patches of red and white clover growing together, and in other places patches of rye-grass and white clover only, in the same field.

I have for some years past been watching the progress of such fields, on their return, successively, to seeds. From the popular notion, that by substituting cow-grass or other clovers, for red clover, the vegetable powers of the land would be recruited so far as to retain the latter, it might naturally be expected not only to find a good stock of plants on those patches, but even a luxuriant crop ; but, whatever may be the prevailing idea upon this point, I have invariably found, upon light land, and where the four and five round course has been practised, that the patches on those parts of the field which before ejected the red clover, became always increased in size, by the plant continuing to decline.

My observations on the strong land, where alternate cropping has been practiced, lead me to believe,

that either peas, beans, or vetches, introduced between the white straw crops, tend more to recruit the vegetable properties of the land, which give it the power to retain the red clover, than any other method that has yet been generally adopted.

The parish of Ashow, near Warwick, adjoins the princely domain of Stonleigh Abbey; and, amongst the many and extensive improvements that have been made there, by the worthy proprietors, within the last twenty years, the farms which lay detached over the parish, have, for the benefit and convenience of the tenants, been laid together. A family of the name of LINES occupied one of these farms, for some years previous to the exchanges; and, as this farm lay dispersed nearly over the whole of the parish, it so happened, that one field or more dropped into the hands of every other occupier. About sixty or seventy years ago, LINES was the only person in the parish that sowed white or Dutch clover; and it is not more than forty or fifty years ago that the seed of that clover has been so generally used. Since the exchanges, the fields of that farm, though they had fallen into many hands, have been treated nearly alike, and yet the different fields are now to be traced to the former occupier, by the failure of the red clover crop.

I have, within the two last years, frequently been through the parish, and have as often remarked the various appearances of the clover fields. The last year I was induced to watch the seeding and progress of two of these fields which are now in the occupation of

MR. DORMER. They adjoin each other, the land is of nearly the same quality, and they have been cropped and treated alike for the last thirty years. The clover came up on both fields alike ; and, having a fine healthy plant, continued to bear the same appearance until the first week in March, when the plant in one of the fields lost its healthy verdure, and the leaf turned blue and yellow ; and I imagined that some of the plants had disappeared. It was then stocked with sheep.

A month had nearly elapsed before I crossed these fields again after I had remarked this alteration ; they were then stocked with sheep, horses, and cattle ; and though one remained in full healthy plant, the other had ejected almost every plant of the red clover. On making inquiry, I found that the field where the red had failed, had been saturated with the white clover seed a much longer time than the other ; and that, I had good reason to conclude, was the cause why it could not retain the red clover plant.

To the following questions, which I put to WILLIAM LINES, an elderly person who had never lived out of the parish, he gave me the annexed answers :—

Q. When you was a youth living with your father, do you remember his mode of mixing his grass seeds ? —A. He sowed rye-grass, and red and white clover ; he was very partial to the latter, and sowed a great deal of it.

Q. Will you describe the crops he used to grow at that time ?—A. They all grew well together, never

failed of a good crop to mow for fodder the first year, and a good pasture for the sheep, the second.

Q. Can you make any observations after your father's death, when your brother occupied the farm?

—A. He never grew such good crops of artificial grasses, though he tilled and seeded the same.

Q. Describe his crops of grass seeds?—A. They were always partial; some places in the field the red was a good swath; in others, all ryegrass and white clover.

Q. You frequently see those fields that were formerly occupied by your father, what are the crops of artificial grasses now?—A. They grow plenty of ryegrass and white clover, but no red; yet all the farmers get some good red on other lands.

Q. As long back as you can remember, can you make any remarks upon this subject?—A. My father was the only person in the parish, who sowed Dutch clover; he used to blame others for not sowing it.

I have been endeavouring lately, to find a tillage farm on no part of which Dutch clover has ever been sown, but my inquiry has not been attended with the desired success. I have met with several single fields, one of which I shall here mention, that has produced three good crops of clover hay within the last twelve months; that is, two last summer, 1829, and one in the present summer, and the plant at the time this was written, was in good progress for a fourth crop. I should not omit to remark, that this field has been husbanded in a slovenly manner, and continually ploughed for the last twenty years.

While residing in London, I frequently visited the hay-markets in that place, to purchase clover-hay for cart horses. Those markets are always supplied with some good hay from all the adjoining counties; and the best clover-hay is that which is the strongest in the stem, and the freest from bents, and is grown by what they term the hay-farmers.

I have before observed, that vetches and clover form a prominent part in their economy of cropping. The whole of their produce is taken to market, except that portion which is kept to maintain and litter their horses; so that they raise no food purposely for sheep.

There is another sort of hay brought to that market by what are called the stock-farmers, which goes under the several denominations of upland meadow, bents, and hard hay. The latter, though at a less price than clover, is much sought after, as rack meat for the heavy horses, whilst the former is principally cut into chaff. Having stated these facts, I shall leave the reader to draw his own conclusions, and to determine, whether the difference I have described in these two descriptions of farms, has been caused by keeping sheep on one of them, or whether that difference has been caused by the species of food raised for the sheep, or that raised for market only.

Farmers now begin to be aware, that although great improvements have taken place of late years, both in the breeding of stock, implements of husbandry, and the cultivation of the soil, there still remains much

to be done, particularly in the latter; and that one of the principal obstructions in the way of improvement are the restrictive clauses injudiciously introduced into covenants. But, surely, prejudice and bad customs should now give way to more rational and more profitable systems. And I trust the time is fast approaching, when one general rule will be laid down and adhered to, in the cultivation of similar soils.

I have good reasons to believe that by applying *Gypsum*, the land, (though it had ceased to grow red clover,) may be made to grow good crops of that plant every fourth year. But, by what I have shown in the last two estimates, and by what I have further to advance, clovers cannot be so profitably introduced as on the eight-year system, more particularly on light land.

Sir H. DAVY, when speaking of *Gypsum*, observes—These earths have been long used in South America, with great success, as a top-dressing for land. They have also been used in Kent, and spoken highly of as an assistant to the growth of artificial grasses.—Peat ashes are used in Berkshire and Wiltshire, as a top-dressing for artificial grasses and are found highly efficacious.

The same eminent writer, in his *Elements of Agricultural Chemistry*, Lecture 7, addressed to the Board of Agriculture, states—that he had examined these ashes, and found them to contain one-third or one-fourth part *Gypsum*. And, again, he says, these ashes are used as a top-dressing for cultivated grasses,

particularly sainfoin and clover. In examining the ashes of ryegrass, sainfoin, and clover, he found that they afforded considerable quantities of gypsum, and that substance probably is intimately combined as a necessary part of their woody fibre. If this be allowed, it is easy to explain why it operates in such small quantities ; for the whole of a clover crop, or sainfoin crop, on an acre, according to my estimation, would afford, by incineration, only three or four bushels of gypsum.

In examining the soil in a field near Newbury, (he continues,) which was taken from beneath a foot-path near the gate, where gypsum could not have been artificially furnished, I could not detect any of this substance in it, and at the very time I collected the soil ashes were being applied to the clover in the field. The reason why gypsum is not generally efficacious, is, probably, because most cultivated soils contain it in sufficient quantities for the use of grasses. *

In the common course of cultivation, gypsum is furnished in the manure, for it is contained in stable dung, and in the dung of all cattle fed on grass ; and it is not taken up in corn crops, or by crops of peas and beans, and in very small quantities in turnip crops ; but where lands are exclusively devoted to pasturage and hay it will be continually consumed.

I have examined (he further observes,) four different soils, cultivated by a series of common courses of crops, for gypsum. One was a light sand from Norfolk ; another a clay, bearing good wheat, from

Middlesex ; the third a sand from Sussex ; the fourth a clay from Essex. I found gypsum in all of them ; and in the Middlesex soil it amounted to nearly one per cent. LORD DUNDAS informs me, that having tried gypsum, without any benefit on two of his estates in Yorkshire, he was induced to have the soil examined for gypsum, and this substance was found in both the soils.

REMARKS.—1st. It appears by science that gypsum is a necessary substance in the earth to promote the growth of grasses, but not necessary for the growth of corn, peas, or beans, and that some soils contain it in sufficient quantities for the purpose of growing grasses ; others are void of it, as in the soil near Newbury, where peat-ashes, containing gypsum, are said to be beneficial.

2d. It appears, by the same analysis, that the other constituents in these ashes, are calcareous, aluminous, and siliceous earths, with variable quantities of potassa, common salt, and sometimes oxide of iron.

3d. Neither of the above earths possessed any particular quality above the common soils, (except the potassa,) and some of them injurious to vegetation. Besides, the small quantity of potassa contained in forty or fifty bushels of peat-ashes, (for that I understand is about the quantity used per acre,) as a top-dressing for grasses, cannot have any material effect, so that the principal benefit must have arisen from the gypsum in former dressings. It appears also that to dress the growing crop in the spring of the

year is an improper time ; and to be of most benefit to the ensuing crop, it should be applied at the time of seeding ; and if drilled in with the seed, three or four bushels per acre, it would have a better effect on the ensuing crop, than a larger quantity sown or spread on the soil. The precise quantity of gypsum that can be beneficially used on an acre of land, must be determined by future experiments.

4th. Red Clover (only) sown with barley or oats, on land, (as I before mentioned,) that has been in tillage an unusual length of time, if put into good heart, will cut three or four good crops the two following years ; but after grasses it seldom is so strong a plant, nor does it remain so long in the land.

The scientific Baronet further remarks—Should these statements be confirmed by future inquiries, a practical inference of some value may be derived from them. It is possible that lands which have ceased to bear good crops of clover, or artificial grasses, may be restored by being manured with gypsum. This article is found near Oxford ; it is likewise abundant in many other parts of England ; in Gloucestershire, Somersetshire, Derbyshire, Yorkshire, &c., and requires only pulverization for its preparation.

5th. I have before mentioned my own observations on young clover, and stated, that it continues in a healthful state from the time it first vegetates, until the spring of the year following, when it sickens and dies. This is, probably, the time the woody fibre spoken of, containing gypsum, lacks the assistance of that

earth ; and as it is found, on analysis, in these plants, it may be regarded as the essential ingredient, with other combinations, subservient to their nourishment.

Since I wrote the former part of this work, I have caused several soils to be analysed, or tried, for gypsum, on the principle described by Sir H. DAVY. The soils have principally been taken from two fields near to each other ; one of them growing good crops of red clover, the other growing them partially, or wholly ejecting the plant. The results have invariably shewn, that those soils which grew the best crops of red clover, were those that contained the most gypsum. I have since compared the sub-soils in the same manner, and found some of them to contain gypsum, although the surface was nearly devoid of that article ; and to this circumstance is to be attributed the cause of clover succeeding in some seasons better than it does in others ; for, after a severe frost, the tap-roots and fibres of the plant perforate more readily into the sub-soil, and, consequently, draw from thence the nutriment they require.

At my recommendation, Mr. JOSEPH JAGGARD, of Woodcote Farm, Warwickshire, sowed on part of a field growing clover, at the latter end of April, 1830, some gypsum, at the rate of about three bushels per acre. The expense of such a dressing would be less than £1. an acre. His labourer, at the time he was sowing the gypsum, was ignorant of the name and quality of the dressing, which appeared to him to be so much useless dust, but, on the 21st of the fol-

lowing June, when the same man was sent with some others to mow the clover, he expressed his astonishment at the improvement which it had made in the crop, and told his master, on his return home, that the dust which he had sown in the spring was a fine dressing for clover.

I saw the crop about three days after it had been cut, and on the two lands that had been dressed with the gypsum, the clover was much stronger than on the other part of the field. The season was remarkably wet, or the gypsum could not have operated so powerfully on the crop in so short a time, as the proper time to apply it, I have no doubt, is at the time of sowing the clover seed, or before Michaelmas, after the barley crop has been cleared off.

CHAP. XI.

ON THIN-SKINNED COLD WHEAT AND OAT LAND—
UTILITY OF OCCASIONAL DEEP PLOUGHING—
NECESSITY OF DRAINING—IMPROVEMENT IN THE
COMMON PLOUGH—THE CUSTOMARY AND IM-
PROVED SYSTEMS COMPARED—VETCH-FALLOWS
PREFERABLE TO SUMMER-FALLOWS FOR CLEAN-
ING AND IMPROVING LAND.

I shall now treat of another sort of land, which often presents to the practical farmer many serious difficulties, when he attempts to bring it into that state of cultivation from which he can reasonably expect to receive an adequate reward for his labour. That is, what is denominated thin-skinned, cold, wheat and oat land, and is not calculated to grow either beans or turnips. I call it wheat and oat land, because, from its tenacious and cohesive quality, and its tendency to hold wet, it is not proper for turnips; and owing to its thin surface soil, and impure sub-soil, it is not calculated to grow crops of peas or beans; although there is often a sufficient mixture of loam on the surface to render it convertible from tillage to artificial grasses. The tillage land on these farms is generally found under its natural state of fertility, as may be observed by the meadows attached to it, and the land lying near

to the homestall, called cow-pastures, or dairy fields, which generally produce the finest flavoured cheese and butter.

This description of land affords little or no profit on the customary mode of tillage. The wheat is most commonly grown after a winter's and summer's fallow ; sometimes immediately after laying two or three years in grass ; and sometimes after a crop of oats ; grass seeds are sown with the oats after the wheat crop. Though here there are only two corn crops to a fallow ; the land having produced clover and grass three years out of the six, and all the dung made from the crops having been applied to the fallow, yet with this management, it neither becomes fertile nor profitable. This sort of land is in general imperfectly drained, and being ploughed in moist weather, some of the surface soil is trampled into the subsoil, and all becomes so firmly bound and united, that it forms a solid body, or to use the canal-makers phrase, it becomes puddled. In this state, it will neither admit of a free circulation of air or of water. This stagnation impregnates and combines in the soil, the oxide of iron, sulphur, and other noxious properties, so that the application of lime becomes indispensable, although the use of it may be injurious to cultivated plants, on this impoverished land. There is also another material drawback, which this kind of land has sustained for centuries, or perhaps since the days of Virgil or Pliny ; that is, the loss of a whole year's produce of dung, every fifth or sixth year, through fallowing, and which will require a

length of time before its natural state of fertility can be restored, or perhaps it may never, without the aid of foreign manure. But, the loss the land has sustained, by being deprived of its manure, is not all, for a green crop would have paid more, every process, than the fallow has lost, in rent and taxes. I state the expense of making a fallow, in the succeeding table, at £6. an acre. I have also estimated a green crop at £4. 10s. an acre only ; but, if we take into account, the fertilizing properties of the green crops in succession, we shall find they far exceed the benefit of a fallow. There are very few practical men, that have hitherto admitted, that fallowing can be dispensed with on all kinds of land : but, I trust I shall satisfactorily shew to the fallowist, in the following pages, by what method they may be dispensed with.

The necessity of thorough draining, has already been demonstrated ; and I shall now advert to the means of fertilizing it by another method. The practical farmer has become a strenuous advocate for deep tillage, and generally admits, that all arable land should be ploughed two or three inches below the usual depth, once in three or four years ; and experience seems to confirm this practice. At the same time, it also teaches us, that it is not necessary to plough deeper than five or six inches in a general way ; but where the sub-soil is become close and permeable to air and water, the plants naturally sicken, and in a wet season, often fail of producing a crop, for want of

a sub-soil, through which the water can penetrate beneath their roots.

I have before observed, that the sub-soils on land of this kind, which are generally poor, cold, and wet, naturally generate and retain noxious properties; and the only objections that I have heard to deep ploughing are, that it throws that soil with all its bad qualities, to the surface. And as it cannot be expected, that all farmers possess chemical knowledge sufficient to detect such noxious qualities, I assert, that when a deeper ploughing is effected on this sort of land, it should be done as early in the autumn as possible, and it would be a safe way, as early in the spring as the land will carry the horses, to harrow in a little quick lime, which will not only render the noxious matter harmless, but nutritive.

There is another way of obviating these difficulties on this sort of land, and I have often been surprised that it has not been put into practice, which is, by breaking up a part of this impermeable sub-soil by an instrument constructed for that purpose, and affixed to the plough, to work in a similar manner to that which the skim-coulter works. This operation would require very little extra power; there would not be any occasion for a breast to turn the furrow; as a slice would merely be cut from the bottom of the last furrow which would be left on the same base. I have no doubt that such a simple apparatus might be constructed to follow the plough; but as the horses in that case, would trample on the loosened earth in

ploughing the next furrow, I would recommend the operation to be performed immediately before the furrow is turned. Many experiments have been made to prove the best method of neutralizing infertile soils, and all agree, that soils exposed to air, and excluded from the sun, become more perfectly and more expeditiously neutralized, than when they are exposed both to sun and air. This may be easily proved by placing a barrowful or two of infertile soil on a spot, exposed to the sun and air, and a similar quantity of the same, excluded from the sun; if in the cellar, or where there is a free admission of air, it will become neutralized, while the former remains steril.

The sub-soil plough, represented by the plate attached to this work, has been made since the former edition was published.

The most economical mode of supplying this worn out earth with food for plants, it will be found, is by encouraging the growth of cattle crops.

Mr. Brown, of Sowe, near Coventry, has lately made a great improvement in the construction of the common plough, by reducing the weight and friction. I saw it at work, in the presence of many practical farmers, with one man and one horse only. They all agreed that the work was as well, and as easily performed with the one horse, as it would be with two in the common plough; it was the last tilth for turnips, and was ploughed the common depth of six inches, and nine inches wide. The same plough, with

a man and an old horse, had a few days before, ploughed an acre in six hours and a half.

Since the above was published, both single and double ploughs, have been mostly made on the above construction, and found to be a great improvement on those formerly in use.

I will now see what profit this land returns, when cultivated in the customary way; and then substituting vetch-fallows for summer-fallows and second year's grass, compare them and state the difference in profits. I take wheat, at 60s. per quarter, as before, and other produce, in the same proportion; both outlay and produce, on the same principle.

CASE IX.—CLASS I.

Eighty Acres of Wheat and Oat Land,

OUTLAY.

	£.	s.	d.
Ploughing, harrowing, &c. 21s., seed and sowing, 18s. weeding, &c. and harvesting, 12s. 6d., taking-in, thrashing, and marketing, 12s. per acre,	42	5	6½
Making fallow, £3. 10s., lime, carting and spreading, 50s. per acre,	79	19	9
Seed, 23s. 6d. ploughing in, dressing, &c. 14s., weeding and harvesting, 16s. 6d., taking in, thrashing and marketing, 17s. 6d.	47	13	0
Tillage, £2. 2s., seed, 18s., weeding and harvesting, 12s. 6d., thrashing, &c. 12s. per acre,	56	6	5½
Clover and grass seeds, 10s. 6d., carting and spreading dung, 18s. per acre,	18	19	11½
Parish tax, 2s. 6d., shepherd, repairs to fences, drains, &c. materials, &c. 6s. 6d.	36	0	0
Interest for capital, 5s., superintending, 7s., housekeeping, &c. 15s. per acre,	108	0	0
	£389	4	8½

The loss on this system, according to the above statement is £25. 12s. 6d., independently of rent. Farms of this description, could not be cultivated on

CASE IX.—CLASS I.

cultivated in the Customary way.

PRODUCE.

A.	R.	P.		£.	s.	d.
13	1	13	Oats, 4 quarters per acre, at 24s.			
			per quarter,	63	19	9½
13	1	13	Fallow,			
13	1	13	Wheat, 21 bushels per acre, at 60s.			
			per quarter,	104	16	3
13	1	13	Oats, as above,	63	19	9½
13	1	13	Artificial grass, £4. 15s. per acre,	63	6	5½
13	1	13	Second year's grass, 45s. per acre,	29	19	10¾
			30 acres straw, pigs, poultry, &c.			
			at 25. per acre,	37	10	0
80	0	0	Total Produce,	£363	12	2¼

	£.	s.	d.
Total Outgoings,	389	4	8¼
Ditto Produce,	363	12	2¼

Loss, £25 12 6

the cost here laid down, and on the above system, were it not for the produce of the dairy, and other better lands.

CASE IX.—CLASS II.

Eighty Acres the same quality as before,

OUTGOINGS.

	£.	s.	d.
Ploughing clover ley, harrowing, &c. 21s. 0d., seed and drilling, 23s. 6d., harvesting, &c. 16s. 6d., thrashing and marketing, 17s. 6d. per acre,	39	5	0
Forking out tufts of couch-grass, manure, cart- ing, &c. £5., ploughing, &c. 21s., seed, &c. 18s., soiling off the crop, 5s. per acre,	72	0	0
Summer and spring tillage, £3. 10s., seed, 18s., harvesting, 12s. 6d., thrashing and mar- keting, 12s. per acre,	56	5	0
Forking out tufts of couch-grass, carting ma- nure, &c. 13s., ploughing, 20s., vetch seed, 18s., grass seeds, 3s. 6d., soiling, 5s. per acre,	29	15	0
Ploughing, &c. as above, for wheat,	39	5	0
Forking stubble and carting manure, &c. and ploughing, 30s., seed, 18s., and soiling, 5s. per acre,	26	10	0
Tillage, summer and spring, £3. 10s., seed and harvesting, &c. as above,	56	5	0
Clover seed, 10s. 6d., Carting dung, 12s. per acre, harvesting 21 tons of clover, at 7s. 6d. per ton,	19	2	6
Parish rates, shepherding, repairs, &c. as before,	36	0	0
Occupier ditto ditto,	108	0	0
	<hr/> <hr/> £482 7 6		

Here again, is a profit of eight shillings per acre,
or 22s. 8½d. if we take into the account the additiona

CASE IX.—CLASS II.

cultivated on the Improved method.

			PRODUCE.			£.	s.	d.
A.	R.	P.						
10	0	0	Wheat 21 bushels per acre, at 60s.					
			per quarter,			78	15	0
10	0	0	Vetches, £4. 10s. per acre, (or part					
			cabbage,)			45	0	0
10	0	0	Oats, 4 quarters per acre, at 24s.					
			per quarter,			48	0	0
10	0	0	Vetches, £4. 10. and grass keep, 15s.					
			per acre,			52	10	0
10	0	0	Wheat, as above,			78	15	0
10	0	0	Vetches, ditto, (or part cabbage,) ..			45	0	0
10	0	0	Oats, ditto,			48	0	0
10	0	0	Clover, 30 cwt. (first mowing,) latter-					
			math equal to 12 cwt. per acre, at					
			£3. 5s. per ton,			68	5	0
			40 acres of straw, pigs, and poultry,					
			at 25s. per acre,			50	0	0
80	0	0						
			Total produce,		£514	5	0	
			Ditto outgoings, ..		482	7	6	
			Rent,		£31	17	6	
					£.	s.	d.	
			Loss on first system,	25	12	6		
			Gain on second,	31	17	6		
			Extra expenditure in manure, 33	7	4½			
					£90	17	4½	

manure, between the two systems, independently of
 meliorating and improving the farm, by the seedless

crops. Besides, where the fork and weeding have been duly attended to for a few years, both weeds and couch-grass have disappeared. The four seedless green crops will furnish the greatest weight, and the most nutritious food for animals, and consequently, the most carbonaceous matter to furnish food for plants.

This is not theoretical, but deduced from actual experience, as will be seen by the following statement of facts ;—It fell to my lot about fifty-six years ago, to occupy a farm, the whole of which, with the exception of four small fields, which I shall have occasion to refer to hereafter, had been recently enclosed. Part of the farm, at the time of the enclosure, was heath and gorse cover. The land principally sandy, with a spurious bottom, and full of surface and rock springs ; and the whole farm had become saturated with both water and land weeds. I put the whole through a process of under-draining.

About this time, drills began to be talked of, and a friend of mine, an early proselyte for improved machinery, had one of Cook's drills, and he was so good as to procure one for me, fitted up with hoes and all the necessary apparatus. But with the hoes and the assistance of all the men in the parish, I should have been a long time in eradicating the weeds out of the farm, had I not been led, by accidental observation, to reflect upon the manner in which the four fields, which I have before alluded to, had been treated, before they came into my occupation. Those fields had formerly been marled, or perhaps they were naturally of a more

compact soil, and had been occupied by two different persons living at a distance. One had no barn on the premises, and his custom was to make a summer fallow every third year; and I have heard it said, that the fallow sometimes would be continued for two years in succession. The produce was principally coltsfoot, charlock, sowthistles, and a little black twitch-grass. Unfortunately, it was some time before I thought of vetch fallows, (tares) which had been very little grown in this part of the country at that time. I adopted the process for about eight or nine years, and although I kept the land in constant cropping, it was perfectly cleared of all roots and seed weeds, and I believe if I had continued the same course of cropping with the same manurings, another eight years, the two fields would have been sufficiently enriched, to have been laid down for feeding pastures.

Many farms consist mostly or wholly of a glutinous or tender soil, and are not calculated to grow any other kind of grain, than wheat and oats, but most of them will grow good crops of one kind of vegetable or other, such as cabbage, rape, winter barley, or oats, and vetches; two crops of either of the latter may be taken in the same season. Rape, may be sown in the autumn, and soiled or eaten off by midsummer, and a crop of vetches grown and eaten off in September; or if vetches be sown in autumn, with a small proportion of winter barley or oats, will be cleared off the ground by the same time, and a second crop grown and cleared off, in time to sow the land with wheat. This is a

system, which in my estimation, ought to be more generally adopted. The stubble should be tolerably clean, but if any tufts of couch appear in the stubble, as before observed, should be forked out before the manure is laid on; if the season be dry, to eat off these crops, the land will be in a much better state for wheat, than if it had been a winter and summer fallow. Tenacious soils, after a fallow, are apt to fall and become dense and hard; if this operation takes place, the succeeding crop is sure to sustain some injury. This falling is prevented by the roots and fibrous matter left in the soil from the green crops, nor does the land become so dense in the succeeding spring and summer, as when the land is made fine by fallowing.

A small quantity of manure applied to the growth of cattle crops, will more effectually improve the farm, than a much larger quantity would do if carried upon a naked fallow. And we find by experience as well as theory, that land, while the crops are growing upon it, both attracts and decomposes nutriment from the atmosphere, which clearly shews that it is impossible for land that is bare of plants, to receive any such benefit. If it be admitted that fallows are of no other use than to rid the land of noxious weeds, then the superiority of the above system is most satisfactorily demonstrated, as every experienced farmer must be aware that it is impossible for weeds to accumulate, or their seeds or roots to remain long in the land, where that system is practised. And if the soil could be enriched by much pulverization, the ploughings for the

winter, and the two summer crops, afford three of the best months in the year for the use of the roller and scuffle, and consequently the land would derive all the advantages that could be imparted to it from these repeated operations.

Mr. ELLMAN, of Sussex, an agriculturist of great eminence, has lately improved his down-land by growing two crops of vetches on the same land in the same year. That is, he eats off his winter grown crop with sheep, in May or the beginning of June; and then he immediately puts in a second crop for the same purpose. These downs, generally, are a dry thin soil; but vetches thrive on almost any land that has a dry substrata, if it be in condition. I should recommend the sowing of rye in preference to vetches, on thin soiled sandy land and bleak situations, for a winter crop, as being the more hardy plant and better able to endure the frosts and cutting winds. And the winter species of vetch, for a summer crop, which from its hardness is better calculated to withstand the heavy falls of rain. On the more tenacious or glutinous soils, a little winter barley or oats, mixed with vetches, have a good effect in protecting the vetch in severe winters.

A summer-fallow, it has generally been considered, is the principal means of disposing the soil to hold moisture and thereby keeping it in a proper state for the nourishment of cultivated plants; but the fact is, that an autumn and winter atmosphere have a much greater share in producing that effect.

CHAP. XII.

SIR HUMPHREY DAVY, AND OTHERS, ON SUMMER FALLOWING—EFFECTS OF THE SUN UPON FALLOWS—FERTILITY NOT ADDED TO THE SOIL BY EXPOSING IT TO OXYGENE—LIGHT—SULPHATES—THE LAND INJURED BY FREQUENT WASHINGS, DURING THE TIME OF FALLOWING.

SIR HUMPHREY DAVY, in his first Lecture to the Board of Agriculture, says—"The chemical theory of fallowing is very simple. Fallowing affords no new source of riches to the soil, it merely tends to produce an accumulation of decomposing matter; which in the common course of crops, would be employed as it is formed, and it is scarcely possible to imagine a single instance of a cultivated soil, which can be supposed to remain fallow for a year with advantage to the farmer. The only cases where this practice is beneficial, seem to be in the destruction of weeds, and for cleansing foul soils.

The benefits arising from fallows have been much over-rated. It has been supposed by some writers, that certain principles, necessary to fertility are derived from the atmosphere, which are exhausted by

a succession of crops, and that these are again supplied during the repose of the land, and the exposure of the pulverized soil to the influence of the air. But this in truth, is not the case. The earths, the great elements of soils, cannot be combined with more oxygene; none of them unite to azote; and such of them as are capable of attracting carbonic acid, are always saturated with it in those soils on which the practice of fallowing is adopted.

The vague ancient opinion of the use of nitre and of nitrous salts, in vegetation, seems to have been one of the principal speculative reasons for the defence of summer-fallows. Nitrous salts are produced during the exposure of soils containing vegetable and animal remains, and in greatest abundance in hot weather; but it is probably by the combination of azote from these remains with oxygene in the atmosphere that the acid is formed; and at the expense of an element, which otherwise would have formed ammonia; the compounds of which are much more efficacious than the nitrous compounds in assisting vegetation.

When weeds are buried in the soil, by their absorption of oxygene and gradual decomposition, they furnish a certain quantity of soluble matter; but it may be doubted whether there is as much useful manure in the land at the end of a clean fallow, as at the time the vegetables clothing the surface were ploughed in. Carbonic acid gas is formed during the whole time by the action of the vegetable matter upon the oxygene of the air, and the greater part of it is

lost to the soil in which it was formed, and dissipated in the atmosphere.

The action of the sun upon the surface of the soil, tends to disengage the gaseous and the volatile fluid matters that it contains ; and heat increases the rapidity of fermentation : and in the summer fallow, nourishment is rapidly produced, at a time when no vegetables are present capable of absorbing it.

Land, when it is not employed in preparing food for animals, should be employed to the purpose of the preparation of manure for plants ; and this is effected by means of green crops, in consequence of the absorption of carbonaceous matter in the carbonic acid of the atmosphere. In a summer's fallow, a period is always lost in which vegetables may be raised, either as food for animals, or as nourishment for the next crop ; and the texture of the soil is not so much improved by its exposure as in winter, when the expansive powers of ice, the gradual dissolution of snows, and the alternations from wet to dry, tend to pulverize it, and to mix its different parts together.

Carbonic acid gas is formed during fermentation, combustion, putrefaction, respiration, and a number of operations taking place upon the surface of the earth ; and there is no other process known in nature by which it can be destroyed, but by vegetation.

The principal consumption of the carbonic acid in the atmosphere, seems to be in affording nourishment to plants, and some of them appear to be supplied with carbon chiefly from this source.

The EARL OF DUNDONALD affirms—"That by exposing the soil on all sides to the action of the atmosphere, in the course of summer-fallowing, the carbonaceous matter it contains is oxygenated and thus becomes insoluble, or at least so refractory that its solubility can only be restored by the application of alkali."

Mr. NAISMITH, in reply, says—"In that case, the accession of oxygene, obtained by summer-fallowing, must be very prejudicial." As the whole of his chemical reasoning on tillage is very interesting, I will copy it.

"Tillage has been generally considered by agriculturists, as the principal means of disposing the soil to hold moisture in a proper state for nourishing cultivated vegetables, and furnishing a convenient lodgement for their roots; by mechanic labour, the cohesion of a dense soil is broken, the parts are separated and made to lie more light and open, while the parts of a porous soil are forced into a more compact state. The different earths of which any soil is composed are more completely blended—the vegetable food which may be locked up in the bosom liberated—the influence of the atmosphere admitted—and the powers of fertility awakened. The mechanical pulverization of the surface tends also to check the violence of exhalation, and retain moisture; and by a well conducted tillage, those useless and noxious weeds, by which cultivated vegetables are robbed of nourishment and checked in their progress, are subdued.

But probably, the advantages accruing from the mechanical operation of tillage, have been overrated;

the reiterated action of the plough and harrow supposed to produce effects which experience does not confirm; and continued summer-fallowing adopted, without proper discrimination.

Land, which by improper management, has been suffered to be overrun with weeds, will often require a summer's culture to free it of those noxious inhabitants. When an unshapely field is to be levelled, and have its form amended, the summer months are the most proper for such operations; and when cohesive soils, a dressing of friable mixtures, to correct their natural defect, it is necessary that the parts of such soils be well divided by mechanical labour, in a dry season, that the mixture may be intimately blended with them. These are perhaps the principal advantages which can be expected from summer-fallow. But the zealous advocates for repeated summer fallowing, are not satisfied with these, and ascribe others, which it will be proper to examine. They assert, first, that by the mechanic operation of a summer, the pulverized soil receives more water, and therefore has more to bestow, for the nourishment of plants in a dry season. Secondly, that by turning all parts of the soil to the influences of the atmosphere, it attracts from thence a more abundant store of nutritious principles. Thirdly, that by this complete exposure of all parts of the soil, the salts inimical to vegetation, contained in it, are washed away by the rains.

With respect to the first of these advantages, supposed to be gained by summer fallowing, cohesive soils

being very much pulverized, exhibit effects directly opposite to what has been supposed. I recollect a number of instances which I could state to this purpose, but I shall confine myself to one which lately occurred to me. In a field of strong clayey soil, which had been three times summer-fallowed, at short intervals, and well dunged every time, the end of a ridge at one corner was not completed; one-half of this corner, which consisted only of a few square yards, had undergone the different operations of summer-fallow, the other had lain in a rough neglected state for forty years or more; when the field was to be laid in grass, that little spot at the end of the ridge was formed with the spade; and the part which had lain rough, appeared mellow and friable, compared with that which had been summer-fallowed. As we have gone along, I have endeavoured to shew that when ground, in any degree cohesive, is much pulverized, it drinks in water greedily, in times of rain, and holds it in an undivided state, hostile rather than favourable to vegetation; and that the cohesive particles being brought in contact, as the excess retires, those particles exert their affinity of aggregation, and coalesce more strictly than before, holding fast what water remains, and refusing admission to the roots of plants. Hence it is a common observation among practical farmers, that summer-fallowing fall or subside, and dense thin soils become harder and thinner. But this will appear in a clearer light, by contrasting with summer fallowing, the effect which an operation directly opposite pro-

duces on the soil. I have repeatedly mentioned the favourable change which all kinds of loose cover on the surface operates, of which any one who is not already convinced, may satisfy himself. Let any spot in a field, free from standing water, be covered, for a year or two, with any substance, even the least corruptible, and if the cover be removed and the field put in a tillage crop, that spot shall be more soft and mellow, and the plants on it more vigorous, and suffer less by the summer's drought, than the rest of the field.

If an operation so opposite communicates to the soil an uncommon faculty of supplying vegetables with nourishment, it must be admitted that the contrary operation of a summer-fallow cannot be strictly proper for the same purpose; and that the chemical operation of nature has, in this respect, the advantage of the mechanical labour of art.—2d, As the repeated turnings of summer-fallow are not adapted to make any permanent improvement in the texture of the soil, so neither does it appear that any additional fertilizing principles are thereby attracted from the atmosphere. We know that gases do become concrete in the soil; since they have been expelled from it by the force of fire. But we are not certain if repeated overturning it attracts them; or if fertility be thereby augmented. Indeed, by an experiment of HUMBOLDT, at present before me, the soil absorbs much oxygene. This experiment seems to be innacurately stated, 400 parts of atmospheric air containing 112 parts of oxygene, were brought in contact with mould; 70 parts disappeared,

only 5 parts of carbonic acid were given out ; and no more than 14 parts of oxygene remained unabsorbed.—No clue is given to assist us to guess what become of $24\frac{1}{2}$ parts of oxygene not accounted for.—The size of the vessel, which contained the air, is not mentioned, but we are sure it could not be large, and may conclude that those 70 parts of oxygene were absorbed by a few inches of surface. If the soil always devoured oxygene in this proportion, those who cultivate the ground, breathing in so defective an atmosphere, would be the most debilitated wretches, and the best cultivated country the most unwholesome. But, on the contrary, we know that those people are the most vigorous of the human race, and that a country becomes more healthful the more it is cultivated.

Besides, the oxygene, combining, as Mr. HUMBOLDT supposes, with the hydrogen and carbon in the soil, would form hydro-carbonous oxyd or acid, which, according to a number of experiments recorded in the first part of this work, would suspend all vegetation, till it should escape in gas, or be washed away by the rain. In either case the principle would be lost, and such absorption of oxygene must impoverish the soil.

But some philosophers, and among these the one last quoted, too intent on the important and indispensable agency of oxygene in vegetation, make the stimulatory power of this gas the cause of almost every process in vegetable economy, and apprehend it can never be administered in too great abundance.—Accordingly, we are told of cresses growing in metallic

oxyds ; such as minium, litharge, massiot, &c. &c. and with astonishing rapidity in oxymuriatic acid. When oxyds neither melt in water nor part with their oxygene, they must be innocent, and plants may grow on them as well as on wet flannel : but I am well persuaded, no plant will vegetate in oxymuriatic acid. I never, indeed, made any experiment with this particular acid, but all the other acids which I have tried, so far as they have any effect on growing vegetables or their seeds, injure or destroy them. I have tried them in various proportions, and never could find that vegetation was stimulated or forwarded by the application. The first effect that I could discover was that of injuring ; and the injury was the greater the more the proportion was increased. All compound substances soluble in water, in which oxygene is in excess, act in the same manner. It is not probable, therefore, that the same gas, in oxymuriatic acid, should produce effects directly opposite to its operation in other cases.

But why should we multiply words to controvert this doctrine, since the phenomena of vegetation give it a complete confutation ?—Do not healthy vegetables throw out much oxygene ? and do they not become pale and sickly when it accumulates in their organs ? It is certain that the animal and vegetable substances which form dung, when exposed to the dry air, till they are deprived of moisture, cease to purify or fall into dissolution. They remain in the state of a dried peat, and yield no vegetable food. I have gathered the dung of cattle, dried on the pastures, pounded it,

and strewed it on spots of grass; but very little increase of verdure appeared during the summer, even after several showers had fallen. Possibly, however, putrefaction is only suspended for want of the agency of water: for when I have macerated the same substance for ten days and poured it on grass, a deeper verdure very soon appeared. But however this may be, when we view the subject on all sides, it does not appear that any new fertility can be added to the soil, by exposing it to the admission of oxygene.

I have hazarded the conjecture all along, that nitrogen or its compounds, combining with the soil, make changes on it, favourable to fertility. But the presence of those gases is not invited by exposing it to the full action of the open air. Of this we are instructed by the manner in which the artificial beds formed for the manufacture of nitre, are managed. Those beds do not attract gas when fully exposed to the air and force of exhalation. They are kept damp, and carefully sheltered from the sun and rain; and it is believed to be an advantage that the air has access to them only from the north. Whatever amelioration, therefore, nitrogen may operate on the soil, summer-fallow can have no share in it.

Carbonic acid seems to be the only ingredient of the atmosphere from which summer-fallow can possibly derive any benefit. But the earths have very little affinity with that gas; sand has none. The small proportion of lime in any soil is always carbonated, that is to say, already saturatad with carbonic acid,

and can attract no more. Some little may possibly be attracted by the clayey part, when it is moist; but as the gas combines more freely with water than with clay, there being no growing plants on fallow to absorb it, the gas will accompany the water and leave the soil. Hence it is evident that the soil, in any other circumstance, is better adapted to receive benefit from the carbonic acid of the atmosphere, than in fallow. And, I may add, the same must be the case with respect to other substances, casually floating in the atmosphere.

It will, perhaps, be said, as light is an important agent in vegetation, and probably a considerable principle in vegetables, repeatedly turning the soil and making it absorb light and caloric, may contribute much to its future fertility. These principles, their natures and combinations, are so imperfectly known, that nothing can be said with certainty on either side. But, with respect to light, in particular, so far as we can observe, its influence seems to be exerted on growing vegetables, rather than on the soil from which they spring. Light destroys the germinating power of seeds. Their first development commences in the dark womb of the earth, where they are fostered, till they are able to bear the light, and to derive benefit from its influence. It is not very probable, that an organ, whose office is conducted in secret, should be better prepared for it by continuing long exposed to the broad glare of day. But if summer-fallows do not derive benefit from the principles of the atmosphere

it may occasion prejudice. It has been already shewn, that the soils frequently contain metallic oxydes, and that the farther those oxydes are removed from the reguline or metallic state, they are the more offensive to vegetation. Now, as metallic substances are oxydated by combination with oxygene or carbonic acid, so far as summer-fallowing exposes those substances more to the influence of the gases, so far is the soil prejudiced by summer-fallowing. With regard to washing pernicious salts from the soil, it would seem proper that we should first know that it contains such salts. In the first part of this work, I have given a number of experiments, to shew, that concentrated acids and the soluble compounds, to which the name of salts is given, which they form with certain bases, are hostile to vegetation, if they are present in such quantity as to have any effect. But acids cannot exist in that part of the surface which we have defined as the soil. They would unite with the rains, which it is well known, must penetrate the soil, otherwise there could be no vegetation; and would either be carried away with the water, as it drained from the field, or be detained by combining with some salifiable base.—If the salt formed by this combination, be soluble, it must be carried away in the same manner: if insoluble, it will remain an innocent ingredient of the soil. Whatever disposition, therefore, there may be in any substance lodged in the soil to combine with oxygene and form acids, or in those acids and salifiable bases to combine and form salts, the rains of every winter must

free the soil from such offensive matters; and I presume it will be found, in all cases, that the sterility of the soil, to the depth of which the roots of vegetables annually cultivated, reach, proceeds rather from the different kinds of defective texture, above described, and from penury of soluble carbon, than from its containing deleterious substances.

But the ingenious Mr. HEADRICK, an experienced chemist, and some time a practical agriculturist, who has taken great pains in examining steril soils, in his "*Essay on Manures, &c.*" addressed to the Board of Agriculture, mentions certain pernicious ingredients which he had discovered in some of them. These were, the sulphates of iron, alumine, and of magnesia, or the principles of which these sulphates are compounded, and the acid frequently in excess. The last, however, he admits, when spread on other grounds, fertilized them. The grounds in which he found those substances, were what he called primitive soils, by which he means those neglected barren fields on which the plough had never acted, and which from neglect, are so consolidated, that the rains cannot penetrate them to any depth. According to the definition given of the soil, in a former part of this work, such grounds must be considered as places from which the soil has been washed away, or is somehow wanting.

Mr. HEADRICK acknowledges, that he never detected salts forming in soils, which had been under the culture of the plough, nor in those which he calls adventitious soils, which he defines to be a mixture of

substances, carried by water, and laid upon the primitive soil or sub-soil. But all soils, capable of fertility, must be somewhat of this adventitious kind. To render therefore, those barren grounds in which pernicious salts are found fertile, their consistence must be changed by ploughing and mixing, and by other means, heretofore prescribed, or to follow hereafter. And the measures pursued to amend their texture, will also free them of their pernicious ingredients.

We always find, that when the earths and other matters, which have been already stated, as the necessary ingredients of a soil, are in just proportions and fitly blendid, it is not necessary to wash any thing away. This is exemplified in the exuberant fertility which we often see displayed by virgin soils, that is, such soils as from the natural fitness of their composition, have been capable of producing a close cover of sweet herbage, and have lain for ages under it, without enjoying the benefit of washing. These, when subjected to tillage, even though they have repeatedly nourished great quantities of coppice and brush-wood, have been found to yield, successively, large cultivated crops, without summer-fallowing. But though it be doubtful if any soil derives benefit from the washings it undergoes in summer-fallow, the loss all ground suffers by such washings, is certain and very considerable; the soil being open, and all sides turned up, much of the pulverized earth is carried away with every heavy shower, and along with it, much carbonaceous matter; the effects of those severe washings, show

the improvidence of summer-fallowing, frequently repeated, in a strong light. Much of the most valuable part of the soil, suspended in water, is carried along the furrows and drains and conveyed into brooks and rivers, where it is for ever lost from the field from whence it is carried. Such is the case, even in moderate declivities; but when the declivity is considerable, the loss is immense; and it is plain, that what is washed away, is the most fertile part: for where little masses are deposited by eddy water by the side of a stream, these are soon covered with luxuriant vegetation.

When wheat is grown after a fallow, and the crop looks of a deep hue, farmers are apt to deceive themselves, by attributing the healthful appearance of the plant to a richness which the land had obtained from the atmosphere, during the time of fallowing; but, from what has been shewn, the luxuriant appearance of the plant, should be attributed to the fibrous and putrescent matter previously deposited in the soil, having become prepared for the succeeding crop, during the suspension of any growing crop that would have exhausted that matter. We know, by experience, that the greater the quantity which the soil contains of the above matter, at the commencement of the fallowing, the more luxuriant will be the crop; and if it contain but little, and no manure is applied, the crop will be sickly, and dwarfish in proportion.

I have frequently heard so much unmeaning discourse about the marvellous improvements which sum-

mer-fallowing was supposed to operate, that I thought it necessary to take a full and candid view of the different agents by which those wonders are supposed to be performed, that people may form a judgment for themselves, when that practice may be proper or necessary, and not be induced by empirical instructors, to expect more from it than sound reason will justify."

I could say a great deal more in support of the subject above treated of, both from my own experience and the high authorities I have quoted, but having first proved that profit and improvement are closely riveted and combined together, common modesty almost forbids another word on the subject.

Summer-fallows have been generally considered as the principal means of disposing the soil to hold moisture in a proper state for nourishing cultivated plants; but in fact, the autumn and winter atmospheres have a much greater share in producing this effect.

CHAP. XIII.

ON LEASES AND COVENANTS—CONDITIONS SHOULD BE ADVANTAGEOUS TO LANDLORD AND TENANT—TENANTS SHOULD BE RESTRICTED FROM PURSUING A BAD SYSTEM—A GOOD SYSTEM WOULD EMPLOY ALL OUR LABOURERS, AND SUPERSEDE IMPORTATION OF CORN—EXAMPLES OF CLOSE CROPPING.

LEASES or Covenants, should contain such clauses as would increase the value of the farm, and should be regarded and employed as a means of introducing the best systems of husbandry and tillage, and particularly so, where a bad one had previously existed. Nay, not only might such agreements casually be so employed, but it is, in truth, the best of all means that can be adopted for that improvement. We have seen how slowly the useful arts extend, and with what difficulty men relinquish the errors of prejudice and habit; in no art, is this more apparent, than in that which relates to the tillage of the ground; where the prejudices of time continue to be riveted with a force, which all the

benefits of example, and all the influence of a persevering instruction, are unable to overcome. It is hardly practicable, however, for a landlord to become directly the instructor of his tenants, who may be ignorant of their art; and it is rarely even expedient, too rudely, to oppose their prejudices. The knowledge to be taught them, is of slow growth, and the value of what is new, can only be made known by a gradual progress of conviction arising from experience; but although a landlord cannot suddenly teach a too ignorant and prejudiced tenantry all that is good, he may often give a better direction to their industry, by restricting them from doing what is wrong; this is particularly easy to accomplish, in whatever relates to that part of the general management of land, which consists in a proper rotation or succession of crops, and a due application of manure.

The conditions in leases, should be such as give the greatest encouragement to the improvement of the estate; and more particularly to such as encourage permanent improvements. It can hardly be expected that a yearly tenant will risk much capital in improvements, unless he have some security for his expenditure. Though liberal landlords often find materials for repairs, and tile for under-draining, yet this is not sufficient to encourage those sort of improvements, that are of much benefit to the estate. Work slightly done often requires a succession, and repetition of expense, in repairs. Under-draining, digging and carting earth, for improving the texture of soils, torrifying

earths, liming, &c., are all lasting improvements ; yet they are often too costly for a young tenant to encounter ; and an old one, often relaxes in these speculations, for the want of a security, such as a clause in the lease, or agreement, to be remunerated by the landlord or succeeding tenant, for such necessary and judicious improvements, for which time and chance have not allowed him an adequate remuneration ; and we need not travel far, in any part of the country, to find this position exemplified. How often do we meet with estates, that have passed from father to son, and from generation to generation, without any visible improvements having been effected upon them ; and this too, on estates, where it had long been the custom of granting what are termed liberal leases, and all for the want of this simple clause ; and at no former period, has such a clause been more called for than the present, when thousands and thousands of poor men are emigrating to foreign nations, for want of corn to thrash, or ground to dig, whereby they might employ themselves usefully to the community, and maintain their families comfortably in their own country. And what is equally as great, or a worse evil, to the inhabitants of the country, is, that every year we are importing immense quantities of grain, of every description, from foreign nations ; while such a clause, or custom, would not only do a great deal towards removing these evils, but would effect a gradual improvement on the estates, and finally benefit both landlord and tenant, as well as confer a blessing on the whole population.

To lay down an approved good course of farming, or one that will, at any rate, impose such restraining covenants upon the tenant, as will prevent him from following a bad system, is easy and practicable; and though that may not altogether make him a good farmer, it will be taking one step, and that no unimportant one, in the progress of improvement.

A question here naturally suggests itself, and I may with great propriety be asked—What is the best course? Then I should briefly answer, that which keeps the farm in the highest state of fertility, and most free from noxious pelf.

In the Improving System, laid down in the foregoing sheets, the presence of all noxious seeds and weeds is invited, that they may be destroyed, with all the insects that they have accumulated and harboured, by the same process; and which, by laying in the young grasses, have been multiplying at least ten-fold every year; and, in course, the longer they are suffered to remain in that state, the more numerous they become, until at last, to destroy them, a summer-fallow becomes indispensable. Though the vegetable covering screens the soil from the scorching rays of the sun, and attracts the carbonic qualities of the atmosphere, yet their returns to the soil are penury itself, when compared with the benefit it receives for luxuriant cattle crops.

It has been often asserted, and with truth, that constant tillage exhausts the soil of its vegetating powers; but then it should be remembered that heavy

crops of green vegetables, consumed by animals on the farm, make great returns to the land, and take less out of it than seed crops do, and if it be judiciously cropped, and the manure is economically managed, they will supply the land with such an additional quantity of soluble matter, that it becomes more enriched than if it had lain in grass.

It has been said again, that tillage gives quantity, and rest gives quality. But we find by the practice that is adopted in open fields, and in other enclosures, which are never put into grass, that they both produce quantity and quality; nor do we hear of any of that land ever becoming tired by a close succession of any species of crop, if it be supplied with a corresponding quantity of manure, excepting red clover; and, as I have before observed, it is probable, that even that plant, may be successfully grown every fourth year, on the same land, by a supply of gypsum, where the land is deficient of it, or has been exhausted of that element.

I could adduce many instances of land having been constantly in crop for a great number of years. A small field within twelve miles of this place, (Kenilworth,) has been cropped with wheat and beans alternately, for two generations; and there are two other fields near this place, that have been under the same course of crops for upwards of thirty years. They have neither been summer-fallowed nor rested in grass, and yet they never fail of producing a crop both in quantity and quality.

About twenty-five or thirty years ago, I saw a field, with a promising crop of wheat upon it, at Mickleton, in Gloucestershire, and I was told it had grown a crop of the same sort of grain, for the last sixteen years, and it always brought a good crop. I saw a small field at Fulham, in Middlesex, that had been appropriated for some years, to the growth of turnips; they were grown for the market, and sometimes two crops were raised in one year; one for early and one for late consumption.

We are informed by chemists, that land producing a fine crop of grain, or a fine-flavoured vegetable, at one time, is always capable of producing the same quantity and quality of grain at all times, under similar circumstances. We know the gardener has his favourite borders for particular vegetables, and often continues the same kind of vegetable on the same border, for a succession of years; but in this instance, there are opportunities of cleaning and preparing the ground for the succeeding crop; but, in the above instance of wheat, there was no vacant time for cleaning the land by horse-labour, and had it not been for the finest and deepest quality of the soil, the hand-labour must have been ineffectual in keeping the land clean.

CHAP. XIV.

ON THE CUSTOMARY MODE OF CROPPING ON LIGHT
OR TURNIP SOILS—BAD EFFECTS OF SANDY AND
DAMP-BOTTOMED LAND LYING TOO LONG OUT
OF TILLAGE—HEAVY WASHINGS INJURIOUS TO
FALLOWS—ADVANTAGES OF CLOSE CROPPING.

I HAVE endeavoured, in the progress of this work, to impress strongly upon the minds of the reader, the good effects that arise from keeping land as closely covered, as can be done with convenience to the occupier, with some sort of vegetables. I have shewn also, the evils resulting to land from the frequent and long exposure of it to the influence of a summer's sun, even on the stubborn and cohesive soils; and I shall now proceed to make some observations on the customary modes of culture and cropping on the light and turnip soils.

I have before said, that this kind of land is applied in various ways. Some look at the improvement which the land receives by laying three or four years in grass. In that case, a crop of oats is generally taken before the wheat crop, and then turnips, and then barley and artificial grasses follow. This course is some-

times laid down by the landlord, under the supposition that it improves the land. In pursuing this system, white clover is supposed to be indispensable, as it constitutes the principal part of the grass pasture, after the first year; but if this system be persisted in, as before observed, it is but of little use to sow any red clover, unless the land be supplied with gypsum; and even the restoration of the red clover will not remedy the whole of the evils attendant upon this system.

There are other difficulties too, that are not so easily met. By the suspension of tillage for four or five successive years, the twitch-grass and consequently the wire-worm, more particularly so on sandy and damp-bottomed land, accumulate in a wonderful manner; and when this noxious weed is suffered to propagate itself to excess, it often penetrates beneath the plough, and although there might be but a small stock at the time of sowing the grass seeds, it becomes so abundant by the time the oats are harvested, that it requires the expense of a fallow to get the land into a proper state for the wheat crop; and besides, the excess of tillage on this kind of land, is found to be unkindly to the growth of that plant; and it is also injurious to the soil, by exposing it afterwards to heavy rains, by which some of its fertile properties are washed off and frittered away.

The effects of these repeated washings, begin to shew themselves in the wheat crop, at the latter end of April or the beginning of May, when the plants on other lands are approaching to that healthy state which

is shown by their deep verdure ; the crops on these over-tilled and under-manured lands, go sickly. This is illustrative in the little farmer, who with his forty or fifty acres, seldom grows turnips, even on his light land, or any other cattle crops, but continually brushes his land for corn crops, until he has weakened it by repeated ploughings, together with the operation of the atmosphere, that it grows little else but charlock, poppy, goldens, sun-flower, and other weeds.

There is another circumstance, in the customary mode of cultivation, that is not unworthy of observation. To suppose that any single season will afford the cultivator a favourable opportunity thoroughly to clean his land, is placing too much dependence by far upon an uncertainty. Now, if we admit that such a system is right, and that such a disappointment does occur, in this or in any similar case, that should not delay the sowing of the turnips beyond the usual season, because that would, in many instances, add a loss to the disappointment. The most certain and the best way to clean the ground in such an emergency, would be to omit the grass seeds for one season, and sow vetches at Michaelmas, and sow the grass seeds with barley, in the following spring. I recommend vetches in preference to turnips, because that crop would supply the place of clover the next summer, and the land, if dunged, will be in fine order for turnips, after the crop of vetches is eaten off ; and if any slug should be discovered, three or four quarters of lime should be sown over the land after the turnip seed has been sown,

and this would have the good effect of checking, if not destroying, those animals.

The advantages of close cropping, both as it regards the land, and the profits of the occupier, can only be known to those who have practiced that system. In fact, Nature herself, by a most wonderful display of her mighty operations, directs us to keep the surface of the earth perpetually clothed, in every instance, where it is practicable, with a luxuriant vegetation. The salubrity of the air is increased, and made more healthy by vegetables alone. There is nothing else known in nature, except vegetation, that absorbs the noxious qualities of the atmosphere, and returns in its stead that oxygene which forms the basis of animal life—hence, the best cultivated countries are always found to be the most healthy.

In the the two comparative systems, page 87, shown that on the customary mode of cultivation, five or six artificial crops are the most that can be grown in eight years. But, in page 107, it is shown, that twelve or thirteen crops may be grown on the same quality of land, in the same number of years; and, I do not hesitate to assert, that the farm becomes more meliorated, from the produce of these extra crops, than if they were omitted.

CHAP. XV.

ON MANURES—IN WHAT STATE FARM-YARD DUNG SHOULD BE APPLIED TO THE LAND—ON GREEN SUCCULENT PLANTS—RAPE-CAKE—DRY STRAW—MERE WOODY FIBRE—INERT PEATY MATTER—BONES—HORN—BONE-DUST—HORN-DUST AND SHAVINGS.

“THERE has been no question on which more difference of opinion has existed, than that of the state in which manure ought to be ploughed into the land ; whether recent, or when it has gone through the process of fermentation ? and this question is still a subject of discussion : but whoever will refer to the simple principles of chemistry, cannot entertain a doubt on the subject. As soon as dung begins to decompose, it throws off its volatile parts, which are the most valuable and most efficient. Dung which has fermented, so as to become a mere soft cohesive mass, has generally lost from one-third to one-half of its most useful constituent elements, and that it may exert its full action upon the plant, and lose none of its nutritive powers, it should evidently be applied much sooner, and long before decomposition has arrived at its ultimate results.

When manures consist principally of matter soluble in water, it is evident that their fermentation or putrefaction should be prevented as much as possible ; and the only cases in which these processes can be useful, are when the manure consists principally of vegetable or animal fibre. The circumstances necessary for the putrefaction of animal substances are similar to those required for the fermentation of vegetable substances ; a temperature above the freezing point, the presence of water, and the presence of oxygene, at least in the first stage of process. To prevent manures from decomposing, they should be preserved dry, defended from the contact of air, and kept as cool as possible.

In the writings of scientific agriculturists, a great mass of facts may be found in favour of the application of farm-yard dung in a recent state. Mr. Young, in his *Essay on Manures*, adduces a number of excellent authorities in support of the plan. Many who doubted, have been lately convinced ; and perhaps there is no subject of investigation in which there is so much an union of theoretical and practical evidence.

I have myself, within the last ten years, witnessed a number of distinct proofs on the subject. I shall content myself with quoting that which ought to have, and I am sure will have, the greatest weight amongst agriculturists. Within the last seven years, Mr. Coke has entirely given up the system formerly adopted on his farm of applying fermented dung ; and he informs me, that his crops have been since as good as ever

they were, and that his manure goes nearly twice as far.

A great objection against slightly fermenting dung is, that weeds spring up more luxuriantly where it is applied. If there be seeds carried out in the dung, they certainly will germinate; but it is seldom that this can be the case to any extent; and if the land is not cleansed of weeds, any kind of manure, fermented or unfermented, will occasion their rapid growth. If slightly fermented farm-yard dung be used as a top-dressing for pastures, the long straw and unfermented vegetable matter remaining on the surface, should be removed as soon as the grass begins to rise vigorously, by raking, and carried back to the dunghill; in this case, no manure will be lost, and the husbandry will be at once clean and economical.

As different manures contain different proportions of the elements necessary to vegetation, so they require different treatment to enable them to produce their full effects in agriculture. I shall, therefore, describe in detail, the properties and nature of manures in common use, and give some general views respecting the best modes of preserving and applying them.

All green succulent plants, contain saccharine or mucilaginous matter, with woody fibre, and readily ferment. They cannot, therefore, if intended for manure, be used too soon after their death. When green crops are to be employed for enriching a soil, they should be ploughed in, if it be possible, when in flower, or at the time the flower is beginning to appear, for

it is at this period that they contain the largest quantity of easily soluble matter.

Green crops, pond weeds, the paring of hedges or ditches, or any kind of fresh vegetable matter, require no preparation to fit them for manure.

The decomposition slowly proceeds beneath the soil; the soluble matters are gradually dissolved, and the slight fermentation that goes on, checked by the want of free communication of air, tends to render the woody fibre soluble, without occasioning the rapid dissipation of elastic matter.

When old pastures are broken up and made arable, not only has the soil been enriched by the death and slow decay of the plants which have left soluble matters in the soil; but the leaves and roots of the grasses living at the time and occupying so large a part of the surface, afford saccharine, mucilaginous and extractive matters, which become immediately the food of the crop, and the gradual decomposition affords supply for successive years.

Rape-cake, which is used with great success as a manure, contains a large quantity of mucilage, some aluminous matter, and a small quantity of oil. This manure should be used recent, and kept as dry as possible before it is applied. It forms an excellent dressing for turnip crops; and is most economically applied by being thrown into the soil at the same time with the seed. Whoever wishes to see this practice in its highest degree of perfection should attend Mr. Coke's annual sheep-shearing, at Holkham.

Dry straw of wheat, oats, barley, beans and peas, and spoiled hay, or any other similar kind of dry vegetable matter is, in all cases, useful manure. In general, such substances are made to ferment before they are employed, though it may be doubted whether the practice should be indiscriminately adopted.

Mere woody fibre seems to be the only vegetable matter that requires fermentation to render it nutritive to plants. Tanner's spent bark is a substance of this kind."

Mr. Young, in his excellent *Essay on Manures*, which gained him the Bedfordian medal of the Bath Agricultural Society, states—"That spent bark seemed rather to hinder than assist vegetation;" which he attributes to the astringent matter that it contains. But, in fact, it is freed from all soluble substances, by the operation of water in the tan-pit; and if injurious to vegetation, the effect is probably owing to its agency upon water, or to its mechanical effects. It is a substance very absorbent and retentive of moisture, and yet not penetrable by the roots of plants.

Inert peaty matter is a substance of the same kind, it remains for years exposed to water and air, without undergoing any change; and in this state, yields little or no nourishment to plants. Experience teaches us these substances are injurious to plants, if applied to the soil before they are reduced to a mould; and in their natural state are very sluggish in becoming reduced, and require two or three years, with repeated turnings and exposure to the atmosphere, to reduce

them to a vegetable mould : and, being of a cold nature, they are found by a heavy dressing to make the greatest improvement on hot gravelly or sandy soils ; on meadow and pasture land, a small quantity of lime in its caustic state, dusted sparingly on the surface while turning, is found to reduce them more easily to a mould, or by a strong mixture of quick lime they may be reduced to ashes. Those who have used them as bedding for pigs or cattle, find by the fermenting of the dung they soon fall into a decay and are of an opinion, by absorbing the soluble part, add to the value of the dunghill. As these substances are of a combustible nature, it might be economically used with other fuel, in the torrifying of clay or marl ; it would both assist as fuel, and the char, or ashes, be an useful ingredient in the soil, though they produce no alkali.

Bones are much used as a manure in the neighbourhood of London. After being broken and boiled for grease, they are sold to the farmer. The more divided they are the more powerful are their effects. The expenses of grinding them in a mill would probably be repaid by the increase of their fertilizing powers ; and, in the state of powder, they might be used in the drill husbandry, and delivered with the seed in the same manner as rape-cake. Bone-dust and bone-shavings, the refuse of the turning manufactory, may be advantageously employed in the same way. The basis of bone is constituted by earthy salts, principally phosphate of lime, with some carbonate

of lime, and phosphate of magnesia; the easily decomposable substances in bone, are fat, gelatine, and cartilage, which seem of the same nature as coagulated alumina.

Horn, is still more powerful manure than bone, as it contains a larger quantity of decomposable animal matter. The animal matter in them seems to be of the nature of coagulated albumin, and it is slowly rendered soluble by the action of water. The earthy matter in horn-shavings or dust, prevents the too rapid decomposition of the animal matter, and renders it very durable in its effects."

Bone dust has been used as a manure in different parts of the country, for many years past, particularly in some of the northern counties. By a report from the Doncaster Agricultural Association, it has been used in Yorkshire and Lincolnshire, for the last ten or twelve years, on the light or sandy soils, with great success, as a dressing for their turnip crop; and as this is an interesting subject, particularly so in this turnip district, and in the immediate neighbourhood of a large comb and horn manufactory, I shall copy one of the paragraphs from the Committee's Report.

"The returns received, satisfactorily establish the great value of bones as a manure, though experiments on manure, in this varying climate, are not much to be depended upon. The seasons, whether wet or dry, the previous state of the land, and the component parts of it, all tend to make experiments doubtful in their comparative results. Yet, where a course of practice, so

long established, as the use of bones, has furnished such an amount of experiments, all doubts may at once be discarded. Our correspondents, with only two exceptions, all concur in stating them to be a highly valuable manure, and on light dry soils, superior to farm-yard dung and all other manures. In copying the language of one of them, with reference to dry sandy soils, we express the opinions repeated in the far greater number. I consider bone-tillage, one of the most useful manures, which has ever been discovered, for the farmer's benefit. The lightness of carriage, its suitability for the drill, and its general fertilizing properties, render it peculiarly valuable in those parts, where distance from towns renders it impossible to procure manures of a heavier and more bulky description; for, as stated by another, the carting of six, eight, or ten loads of manure per acre, for one mile only, is no trifling expense. The use of bones, diminishes labour, at a season of the year too, when time is of the first importance, for one waggon load of one hundred and twenty bushels of small drill bones, is equal to forty or fifty cart loads of fold-manure."

There were formerly about five thousand bushels of horn-shavings sold for manure annually, to the neighbouring farmers, from the comb and lanthorn manufactories of this place, (Kenilworth) at about 10*d.* per bushel; the trade has since declined. There are now about half that quantity, and sold at about 12*d.* per bushel; they were formerly principally applied to the wheat fallow, but are now mostly used on the light

land ; they are found to be an excellent manure for turnips and other green crops : the quantity usually applied is, from forty to sixty bushels per acre. They are sowed over the land by hand, prior to the last tilth. They are also used by the manufacturers and others, as manure for their gardens, and are found to answer for culinary purposes, better than dung ; the spring cabbage, in particular, for being earlier and finer in flavour, than when dung has been applied.

The Report from the Doncaster Agricultural Association, as above mentioned, is decidedly in favour of the application of bone-dust to the light soils, and more particularly for the growth of turnips, but from the analysis, both bone and horn, are constituted of nearly the same properties, and their operation in the soil is the same ; and it is probable, that horn would be found to have the same effect on light soil, as the bone-dust, if applied for the same purpose, though horn-shavings cannot be so conveniently used with the drill, without some preparation ; but where it is desirable to drill for a turnip crop, the shavings might be sowed and ploughed in, in two or one bout ridges, and the seed drilled upon the ridge.

The only objection that I hear of, to this mode of husbandry, is the after ploughing, and the difficulty there is found in mixing the dung with the soil ; but, where the land can be readily ploughed across the ridges, this difficulty is obviated at once. In other respects, the practice is attended with great advantages : less dung or other manure, is sufficient — there is a

greater depth of soil for the turnips to root in—they are hoed or cleaned at a less expense—and on tender land, from the turnips being seated on a drier and more permeable bottom, they are more readily come at in time of frost and snow—and when the crop is taken off, the land is better able to carry the carts.

When cabbage or turnips are to be taken off tender land, it is better to avoid carting on it, and move them to the headland or road-side, in baskets; but if planted on ridges, with intervals at twenty-seven inches, both horses and wheels go in the furrow, and the crop may be carted off, with little or no injury to the succeeding crop.

CHAP. XVI.

ON MANURES—CHALKS—BURNT-LIME—QUICK-LIME—
SLAKED-LIME—MILD-LIME—GENERAL REMARKS.

“CHALKS, calcareous marls, or powdered limestones, act merely by forming an useful earthy ingredient of the soil, and their efficacy is proportioned to the deficiency of calcareous matter, which, in larger or smaller quantities, seems to be an essential ingredient of all fertile soils; necessary, perhaps, to their proper texture, and as an ingredient in the organs of plants.

Burnt-lime, in its first effect, acts as a decomposing agent upon animal or vegetable matter, and seems to bring it into a state, in which it becomes more rapidly a vegetable nourishment; gradually, however, the lime is neutralized by carbonic acid, and converted into a substance analagous to chalk; but in this case, it more perfectly mixes with the other ingredients of the soil, is more generally diffused and finely divided; and it is probably more useful to land than any calcareous substance in its natural state.

Quick-lime, in its pure state, whether in powder or dissolved in water, is injurious to plants. But lime, in its state of combination with carbonic acid, is an useful ingredient in soils. Calcareous earth is found in the ashes of the greater number of plants; and exposed to the air, lime cannot long continue caustic, for the reasons above mentioned, but soon becomes united to carbonic acid. When newly burnt lime is exposed to air, it soon falls into powder; in this case, it is called slaked lime; and the same effect is immediately produced by throwing water upon it, when it heats violently, and the water disappears.

Slaked-lime, is merely a combination of lime with about one-third of its weight of water; *i. e.* 55 parts of lime absorb 17 parts of water; and in this case, it is composed of a definite proportion of lime to a definite proportion of water, and is called by chemists—hydrate of lime; and when hydrate of lime becomes carbonate of lime, by long exposure to air, the water is expelled and the carbonic acid gas takes its place. When lime, whether freshly burnt or slaked, is mixed with any moist fibrous vegetable matter, there is a strong action between the lime and the vegetable matter, and they form a kind of compost together, of which a part is usually soluble in water. By this kind of operation, lime renders matter, which was before comparatively inert, nutritive; and as charcoal and oxygene abound in all vegetable matters, it becomes, at the same time, converted into carbonate of lime.

Mild-lime, powdered limestone, marls or chalks, have no action of this kind upon vegetable matter ; by their action, they prevent the too rapid decomposition of substances already dissolved ; but they have no tendency to form soluble matters. It is obvious from these circumstances, that the operation of quick-lime, and marl or chalk, depends upon principles altogether different.

Quick-lime, in being applied to land, tends to bring any hard vegetable matter that it contains, into a state of more rapid decomposition and solution, so as to render it a proper food for plants.

Chalk and marl, or carbonate of lime, will only improve the texture of the soil, or its relation to absorption ; it acts merely as one of its earthy ingredients.

Quick-lime, when it becomes mild, operates in the same manner as chalk ; but, in the act of becoming mild, it prepares soluble out of insoluble matter. It is upon this circumstance, that the operation of lime, in the preparation for wheat crops, depends ; and its efficacy in fertilizing peats, and in bringing into a state of cultivation, all soils abounding in hard roots or dry fibre, or inert vegetable matter.

The solution of the question, whether quick-lime ought to be applied to a soil, depends upon the quantity of inert vegetable matter that it contains.

The solution of the question, whether marl, mild-lime, or powdered limestone, ought to be applied, depends upon the quantity of calcareous matter already in the soil.

All soils are improved by mild-lime, and ultimately, by quick-lime, which do not effervesce with acids; and sands more than clays.

When a soil, deficient in calcareous matter, contains much soluble vegetable manure, the application of quick-lime should always be avoided, as it either tends to decompose the soluble matters, by uniting to their carbon and oxygene, so as to become mild-lime, or it combines with the soluble matters, and forms compounds, having less attraction for water than the pure vegetable substance.

The case is the same, with respect to most animal manures; but the operation of the lime is different, in different cases, and depends upon the nature of the animal matter. Lime, forms a kind of insoluble soap, with oily matters, and then gradually decomposes them, by separating from them oxygene and carbon. It combines likewise with the animal acids; and, probably, assists their decomposition, by abstracting carbonaceous matter from them, combined with oxygene; and consequently, it must render them less nutritive.

It tends to diminish, likewise, the nutritive powers of albumen, from the same causes; and always destroys to a certain extent, the efficacy of animal manures, either by combining with certain of their elements, or by giving to them new arrangements. Lime, should never be applied with animal manures, unless they are too rich, or for the purpose of preventing effluvia.

It is injurious when mixed with any common dung, and tends to render the extractive matter insoluble."

REMARKS.—Experience teaches, that lime, when applied to land, has different effects upon some soils, than it has upon others. When applied to some land, we find a rapid and permanent improvement; when it is applied to others, we find less benefit from it; and, on some soils, lime is said rather to retard than promote vegetation; but, by comparing science with practice, that probably may afford us some guide, by which we may apply lime to land more economically and usefully.

In quoting the above high authority, we find that lime, by different chemical operations and effects, possesses different constituent principles, and in its first or caustic state, has the power of bringing inert matter progressively into solution; namely, those substances that have lain sluggish or dormant in [the soils; such as woody fibre, or infertile earth, that may have been brought near to the surface by deeper ploughing, or any of the oxides or acids, that may have accumulated by stagnant waters. In such cases, quick-lime seems to have the property of rapidly bringing those substances into a state of fertility. Clays and heavy soils, that have lain a considerable time in grass, when converted into tillage, seem not only to afford instances where quick-lime may be applied economically, but its application appears to be absolutely necessary, to render such land fertile. These lands, while in grass, often become mossy, or, what is termed in common phraseology, sour land. We know, by experience, that a dressing of quick-lime over the surface, destroys moss and sweetens the turf. And we find, by theory,

that inert matter under the surface of the earth, is converted by quick-lime into fluids, that become useful to vegetation.

We are told, that when lime has lost its caustic properties, it then only acts as an ingredient in the soil; but some Professors of Natural Philosophy, seem to be divided in their opinions with regard to any other change that it may undergo by attraction. We know, that when lime is laid on grass land in the spring, or in the autumn of the year, the land so dressed, soon becomes covered with grass, and in its carbonic state, feels hard under foot; and that after it has lain a time, it becomes soft and mellow. Some theorists say, that lime loses carbonic gas and attracts and becomes nitrate; if such be the case, it appears that it must be the effect of the particular situation it lays in, and not being mixed with the soil, although shaded by the grass from the influence of the atmosphere.

We also find, by practice, that quick-lime, when brought in contact with dung, abstracts some of its nutritive properties, and if dung and lime are both to be applied to the land the same season, the lime should be well mixed with the soil, and become carbonated, before the dung is laid on. The same rule should always be observed, in making lime and dung compost. This practice, is further illustrated, in spreading quick-lime over a spot in the field, from whence a dunghill has been removed. In those instances, every farmer must have observed, that the succeeding crops must have grown too luxuriantly on that part, and that the

straw has often rotted on the ground ; but when quick-lime has been applied plentifully to that spot, the straw, has grown sufficiently strong, and produced a fine sample of grain. How absurd, then, must be the practice of mixing quick-lime and dung !

In either case, if such soil contain a sufficient mixture of calcareous earths, less lime than the usual quantity will be sufficient to decompose any inert or pernicious matter the soil may contain, provided the lime is reduced to a fine powder, by being well exposed to the air by turning. But when lime is applied to clay or heavy tillage land, either for the purpose of reducing its cohesive properties, or supplying an additional quantity of calcareous earth, small dressings of lime will have but little effect ; and if sand or calcareous earths are to be employed for the same purpose, it appears that it would be more desirable, in point of economy, to apply them separately, than as a compost. For, in this case, lime has absorbed one-third of its weight of water, and is then called hydrate of lime, and has lost, in part, those mechanical properties which effect that purpose.

When the object one has in view, is to prevent a cohesive attraction, the clods should be reduced, to give lime all the advantages of mixing with the soil ; but when the land is intended to be quickly planted, it should be kept in memory, that lime in its caustic state, is pernicious to plants, and should have time, when mixed with the soil, to become carbonated, before the fibres of the plant have gained much strength.

Lime and soil compost, will be more economically employed on meadow or grass land, by mixing light soil with the lime for the heavy land, and heavy soil with it for the light land.

The mechanical operation of lime on sandy or friable soils, seems to be its tendency to unite and combine with the fine particles of sand, which causes that land to attract and absorb more moisture, and to impart it more gradually, and if the weather be dry, it retains that moisture longer ; and this is the reason why lime is said to be cooling to hot land.

When marl or clay, is to be applied in considerable quantities, for the improvement of its texture, to sandy soils—the best way is to lay it on the surface before the winter's frosts have subsided, so that it may be sufficiently exposed to the action of the weather, that the clods may be reduced by the operation of the harrow, before the tillage is began to prepare the land for the succeeding crop ; as one of the principal advantages to be obtained from the application of marl or clay to sandy soils, is to give them power to collect more moisture, and to retain it more tenaciously ; and then it must undoubtedly follow, that the more regularly the sand and the clay are blended and mixed together, the greater will be the effect.

CHAP. XVII.

ON THE IMPROVEMENT OF LANDS BY BURNING; CHEMICAL PRINCIPLES OF THIS OPERATION.

“THE improvement of steril lands by burning, was known to the Romans. It is mentioned by Virgil, in the first book of the Georgics : “*Sæpe etiam steriles incendere profuit agros.*” It is a practice still much in use in many parts of these islands; the theory of its operation has occasioned much discussion, both among scientific men and farmers. It rests entirely upon chemical doctrines; and I trust, I shall be able to offer you satisfactory elucidations on the subject.

The basis of all common soils, are mixtures of the primitive earths and oxide of iron; and these earths have a certain degree of attraction for each other. To regard this attraction, in its proper point of view, it is only necessary to consider the composition of any common siliceous stone. Feldspar, for instance, contains siliceous, aluminous, calcareous earths, fixed alkali, and oxide of iron, which exist in one compound, in consequence of their chemical attractions for each

other. Let this stone be ground into impalpable powder, it then becomes a substance like clay : if the powder be heated very strongly it fuses, and on cooling forms a coherent mass similar to the original stone ; the parts separated by mechanical division adhere again in consequence of chemical attraction. If the powder is heated less strongly, the particles only superficially combine with each other, and form a gritty mass, which, when broken into pieces, has the characters of sand.

If the power of the powdered feldspar to absorb water from the atmosphere, before and after the application of the heat, be compared, it is found much less in the last case.

The same effect takes place when the powder of other siliceous or aluminous stones is made the subject of experiment.

I found that two equal portions of basalt, ground into impalpable powder, of which one had been strongly ignited, and the other exposed only to a temperature equal to that of boiling water, gained very different weights in the same time when exposed to air. In four hours the one had gained only two grains, whilst the other had gained seven grains.

When clay or tenacious soils are burnt, the effect is of the same kind ; they are brought nearer to a state analogous to that of sands.

In the manufacture of bricks, the general principle is well illustrated ; if a piece of dry brick earth be applied to the tongue it will adhere to it very

strongly, in consequence of its power to absorb water ; but after it has been burnt there will be scarcely a sensible adhesion.

The process of burning renders the soil less compact, less tenacious and retentive of moisture ; and when properly applied, may convert a matter that was stiff, damp, and in consequence cold, into one powdery, dry and warm ; and much more proper as a bed for vegetable life.

The great objection made by speculative chemists to paring and burning, is, that it destroys vegetable and animal matter, or the manure in the soil ; but in cases in which the texture of its earthy ingredients is permanently improved, there is more than a compensation for this temporary disadvantage. And in some soils where there is an excess of inert vegetable matter, the destruction of it must be beneficial ; and the carbonaceous matter remaining in the ashes may be more useful to the crop than the vegetable fibre, from which it was produced.

I have examined by a chemical analysis, three specimens of ashes, from different lands that had undergone paring and burning. The first was a quantity sent to the Board, by Mr. Boys, of Bellhanger, in Kent ; they were from a chalk soil, and 200 grains contained—

80 Carbonate of lime.

11 Gypsum.

9 Charcoal.

15 Oxide of iron.

3 Saline matter.

Sulphate of potash.

Muriate of magnesia, with a minute
quantity of vegetable alkali.

The remainder alumina and silicia.

Mr. Boys estimates that 2660 bushels are the common produce of an acre of ground, which, according to his calculation, would give 172,900 lbs., containing—

Carbonate of lime	-	69160	lbs.
Gypsum	- - -	9509.5	
Oxide of iron	- - -	12967.5	
Saline matter	- - -	2593.5	
Charcoal	- - -	7780.5	

In this instance, there was undoubtedly a very considerable quantity of matter capable of being active as manure produced in the operation of burning. The charcoal was very finely divided; and exposed on a large surface on the field, must have been gradually converted into carbonic acid. And gypsum and oxide of iron, as before mentioned seem to produce the very best effects when applied to lands containing an excess of carbonate of lime.

The second specimen was from a soil near Coleorton, in Leicestershire, containing only four per cent. of carbonate of lime, and consisting of three-fourths light siliceous sand, and about one-fourth clay. This had been turf before burning, and 100 parts of the ashes gave—

6 parts Charcoal.

3 Muriate of soda and sulphate of potash,
with a trace of vegetable alkali.

9 Oxide of iron.

And the remainder the earths.

In this instance, as in the other, finely divided charcoal was found; the solubility of which would be increased by the presence of the alkali.

The third instance, was that of a stiff clay, from Mount's Bay, Cornwall. This land had been brought into cultivation from a heath by burning about ten years before; but having been neglected, furze was springing up in different parts of it, which gave rise to the second paring and burning. 100 parts of the ashes contained—

8 parts of charcoal.

2 of saline matter principally common salt,
with a little vegetable alkali.

7 Oxide of iron.

2 Carbonate of lime.

Remainder alumina and silica.

Here the quantity of charcoal was greater than in the other instances. The salt, I suspect, was owing to the vicinity of the sea, it being but two miles off. In this land, there was certainly an excess of dead vegetable fibre, as well as unprofitable living vegetable matter: and, I have since heard, that a great improvement took place.

Many obscure causes have been referred to for the purpose of explaining the effects of paring and burning; but I believe they may be referred entirely

to the diminution of the coherence and tenacity of clays, and to the destruction of inert and useless vegetable matter, and its conversion into a manure.

Dr. Darwin, in his *Phytologia*, has supposed, that clay, during torrefaction, may absorb some nutritive principles from the atmosphere, that afterwards may be supplied to plants; but the earths are pure metallic oxides, saturated with oxygen; and the tendency of burning, is to expel any other volatile principles that they may contain in combination. If the oxide of iron in soils, is not saturated with oxygen, torrefaction tends to produce its further union with this principle; and hence, in burning, the colour of clays changes to red. The oxide of iron, containing its full proportion of oxygen has less attraction for acids than the other oxide, and is consequently less likely to be dissolved by any fluid acids in the soil; and it appears in this state to act in the same manner as the earths. A very ingenious author, Mr. Naismith, supposes that the oxide of iron, when combined with carbonic acid, is poisonous to plants; and that one use of torrefaction is, to expel the carbonic acid from it; but the carbonate of iron is not soluble in water, and is a very inert substance; and I have raised a luxuriant crop of cresses in a soil, composed of one-fifth carbonate of iron and four-fifths carbonate of lime. Carbonate of iron, abounds in some of the most fertile soils in England, particularly the red hop soil. And there is no theoretical ground for supposing, that carbonic acid, which is an essential food of plants, should in any of

its combinations, be poisonous to them; and it is known, that lime and magnesia are both noxious to vegetation, unless combined with this principle.

All soils, that contain too much dead vegetable fibre, and which, consequently, lose from one third to one-half of their weight, by incineration, and all such as contain their earthy constituents, in an impalpable state of division, *i. e.* the stiff clays and marls, are improved by burning; but, in coarse sands, or rich soils, containing a just mixture of the earths, and in all cases in which the texture is already sufficiently loose, or the organizable matter sufficiently soluble, the process of torrefaction cannot be useful.

All poor siliceous sands must be injured by it; and here, practice is found to accord with theory. Mr. Young, in his *Essay on Manures*, states—‘that he found burning, injure sand;’ and the operation is never performed by good agriculturists, upon siliceous sandy soils, after they have once been brought into cultivation.”

It appears, both by theory and practice, that sandy land and those soils which have a proper mixture of their earthy constituents, may be injured by paring and burning; or such land, that exhibits a natural state of fertility, should never be put under that process: but all clays or heavy land, may be improved in their texture and fertility, if under their natural state of cultivation; or heavy cold lands, that have laid a long time in grass, and become covered with moss, or have accumulated any other inert or

noxious matter, are the most proper soils to pare and burn.

I need not have cautioned the frugal cultivator against paring and burning fertile soils, most probable the expense in the process, will confine the practice to such soils as are infertile. In the first case above reported, where the produce of burnt earth is 2660 bushels per acre, the expense must have been very considerable. Mr. Boys, or the Board, has published a Treatise on Paring and Burning, but I have not seen it; but if the whole of the 2660 bushels was again applied to the acre, it could not have been less than sixty-five or seventy three-horse cart load per acre, and must have cost, when worked into the soil, from three to four shillings per load, and such a dressing would constitute nearly one-twentieth part of the surface soil, and from the ingredients the ashes produced, must have caused great fertility in the soil, as well as a permanent improvement to the texture of it. I have seen a wonderful improvement by the dust from a brick-kiln being laid on a heavy soil at only about twenty loads per acre. Indeed, we know, any substance that has the tendency to absorb moisture, will tend to break the adhesive quality of clay soils, and cause a repulsion on changes of weather; such as coal-ashes, lime, rubbish, or any dry earth from old buildings: all such materials, should be applied to the strong soils. I had an opportunity some time ago, of viewing two fields that had been dressed over with burnt-earth, dug from the headlands of the same fields,

at about forty cart-loads per acre ; these were a strong waterproof clay, the earth appeared to have been irregularly burnt, and the clods not sufficiently broken to mix with the soil. There was a clamp burning at the same time, in an adjoining field. It appeared to have been thrown together promiscuously, and the fuel irregularly intermixed with the earth. I observed the clamp to fall in places, which caused the fire to draw stronger in one part than another, so that it was no wonder the earth dressed over the other fields was not regularly burnt. I suggested, by way of improvement, to form a wall of turf on two sides intended for the clamp, about twelve or fourteen feet asunder ; and the earth, when dug up in square lumps and a little dried, placed regularly on the fuel inclosed by the walls ; when piled up to about four feet from the hearth, to form a grating by iron rods lodged on the wall to support a second course, which may be continued to any height or length required. By this means, the turf will become improved by the fire, without destroying the carbon, or other vegetable matter it may contain, which is an objection very justly observed, against paring and burning fertile land. In this process, the earth would be placed directly on the fuel, and will become more regularly torrifed, as well as a saving in fuel ; it is estimated that wood and coal, equal in value to one ton of coal, will be sufficient to torrify thirty yards of earth. It should still be kept in memory, that one of the principal improvements to be obtained in the application of burnt earth to clays or

heavy soils, is to alter the constituent properties of the soil, to give it more friability to work, and causing a less cohesive adherence, to admit its absorbing and giving out moisture to plants more freely ; and that great improvements are not to be expected from small dressings.

I have before mentioned the good effects alternate green and white strawed crops have on this sort of land ; the stubbles and roots of plants being always fresh in the soil, tends to break the cohesive qualities of such soils, and may be compared in their use in the soil, to the use of stubble or chopped straw applied to clay, while being prepared for earthen walls, or forming the ridge for thatched buildings ; we find this sort of land always to set or become more dense after a summer fallow, than after a crop, which in part may be attributed to the stubble and roots of plants from the foregoing crops, having the effect to assist both expansion and repression on the common variations of the weather.

CHAP. XVIII.

ON IRRIGATING OR WATERING LAND.

“IRRIGATION, or watering land, is a practice, which at first view, appears the reverse of torrefaction ; and in general, in nature, the operation of water is to bring earthy substances into an extreme state of division. But in the artificial watering of meadows, the beneficial effects depend upon many different causes, some chemical, some mechanical.

Water is absolutely essential to vegetation ; and when land has been covered by water in the winter, or in the beginning of spring, the moisture that has penetrated deep into the soil, and even the sub-soil, becomes a source of nourishment to the roots of the plant in the summer, and prevents those bad effects that often happen in lands in their natural state, from a long continuance of dry weather.

When the water used in irrigation has flowed over a calcareous country, it is generally found impregnated with carbonate of lime ; and in this state, it tends, in many instances, to ameliorate the soil.

Common river-water also generally contains a certain portion of organizable matter, which is much greater after rains, than at other times ; and which exists in the largest quantity, when the stream rises in a cultivated country.

Even in cases when the water used for flooding is pure, and free from animal or vegetable substances, it acts by causing the more equable diffusion of nutritive matter existing in the land ; and in very cold seasons it preserves the tender roots and leaves of the grass from being affected by the frost.

Water is of greater specific gravity at 42° Fahrenheit, than at 32° , the freezing point ; and hence, in a meadow irrigated in winter, the water immediately in contact with the grass is rarely below 40° , a degree of temperature not at all prejudicial to the living organs of plants.

In 1804, in the month of March, I examined the temperature in a water meadow near Hungerford, in Berkshire, by a very delicate thermometer. The temperature of the air at seven in the morning was 29° . The water was frozen above the grass. The temperature of the soil below the water in which the roots of the grass were fixed, was 43° .

In general, those waters which breed the best fish, are the best fitted for watering meadows ; but most of the benefits of irrigation may be derived from any kind of water. It is, however, a general principle, that waters containing ferruginous impregnations, though possessed of fertilizing effects, when applied to

a calcareous soil, are injurious on soils that do not effervesce with acids; and that calcareous waters, which are known by the earthy deposit they afford when boiled, are of most use on siliceous soils, or other soils, containing no remarkable quantity of carbonate of lime.”

Considering the great benefit to be derived from irrigation, and the numerous opportunities that offer in different parts of the country, I cannot help thinking artificial watering is very much neglected; though there cannot be a doubt but it is practised more or less in all parts of the country, yet there are many opportunities offer, where it might be put in practice at a very trifling expense, particularly from the small brooks or rivulets, where the sand-beds and scours, in some instances, form a stoppage sufficient for carrying the water by trench or dyke, from the higher to the lower levels, and by different carriers and alternate drains, the water might be conveyed over a considerable surface of pasture or meadow land; or on the larger brooks where there is no mill or other obstruction to prevent it, a floodgate or cascade might be erected, and in some instances a head of water might be raised at an inconsiderable expense, compared with the permanent improvements to be derived from it. Water sometimes is conveyed by this means and thrown over land at a considerable distance; but artificial watering is better understood in some counties than others; it is very much practised in Wiltshire, Berkshire, and the adjoining counties, and very much extolled.

Their practice and theory of laying out meadows, has been published, with plates, shewing the formation of meadows, with carriers and drains necessary for keeping the water in a constant and regular circulation over the surface. I recollect once seeing one of these meadows stocked in the month of March with ewes and lambs feeding on a fine pasture, when the different parts of the country were barren of either grass or turnips. This meadow had been formed into panes or beds, at a considerable expense, and the water brought from the head of a mill-dam to a considerable distance; the panes were about three acres each, formed into elevated ridges of about sixty feet wide, with a hollow down each ridge connected with the culvert or carrier on the level at the upper part of the pane; the hollow down the ridges formed wider and deeper to spill the water regularly down the slopes of the ridges, with grips down the furrows in the reverse form, which conveyed the water into another head culvert to water a second pane; and was continued on in succession through a second meadow. I understood these meadows often produced two good crops of hay in the year, and never required dung or any other manure.

Besides this kind of watering, there is another called catch-watering, which is much practised in the hilly part of Devonshire, by conveying the washings of roads to the higher levels of meadows, which are often situated below the roads, and by forming a small canal at the upper level of the meadow, the water is regularly circulated by other catch or receiving

trenches across the meadow. I have seen these waters connected with the current from springs and conveyed on the level to the top of a sloping hill in grass fields; and the water circulated on the declivity by the same means as the above, over a considerable surface, with a good effect; this improvement is often to be seen in that county, at a great distance from the roads.

We find by experience, as well as theory, that all floating has the best effect upon those meadows that have a dry and permeable bottom; and we are informed by theory, that water which flows from a cultivated country, contains the most carbonaceous matter; and, for artificial watering, those waters that run through a calcareous country, are the most proper for meadows situated on gravelly or sandy bottoms; and those flowing from the neighbourhood of metallic rocks, should not be put over meadows containing calcareous earths, or such as effervesce with acids; and we also find by experience, in all cases, that those meadows on dry and permeable bottoms, are the most benefited by floating, and the clayey or impermeable bottoms, the least benefited by that process.

CHAP. XIX.

ON COMMON SALT AS A MANURE—ON ALKALIES AND
SALINE SUBSTANCES — SAUSSURE'S TABLES ON
VEGETATION—ON THE FOOD OF PLANTS—TULL'S
SYSTEM OF CULTURE — ERRORS IN HORTICUL-
TURE — SIR H. DAVY'S ANALYTICAL TABLES —
OBSERVATIONS.

COMMON salt has been used as a manure, and it is said, that in some cases, it has proved efficacious ; others that have used it, have not perceived any benefit from it ; and in some instances, it has proved injurious. We are told by some theorists, that the saline substances are a direct poison to vegetables ; and indeed, we read in the Scriptures, that salt has been sown on the land for the purpose of rendering it barren. Yet, we know, that all lands near the sea, are highly impregnated with salt, and are both fruitful and healthful.

Theorists have asserted, that most soils contain salt by nature ; and they also lead us to understand, that all animal and vegetable manures contain salt, and the more dung is fermented, the more salts it accumulates. Sandstone rocks are impregnated with salt ;

and some rocks produce it nearly in a pure state. Many others of the earths contain saline properties, and they must naturally exist in those soils which are derived from those rocks ; and probably, in a sufficient quantity for vegetable purposes.

Alkaline earth and alkalies, and many other of the saline substances, have been used and recommended for the purpose of increasing vegetation.—Dr. Holme states, “ that sulphate of potassa found in the ashes of some plants, is an useful manure.” But Mr. Naismith questions his results, and quotes experiments hostile to his opinions ; and, as he conceives, unfavourable to the efficacy of any species of saline manure.

Sir H. Davy says—“ much of the discordance of the evidence relating to the efficacy of saline substances, depends on the circumstance of their having been used in different proportions, and in general, in quantities too large ; and he gives the results of many experiments, which prove that salt is injurious to plants, when applied in large quantities, but innocent, when but small quantities of it are used. When he applied a solution of water mixed with 1-300th part of saline compound to plants, it was innocent ; or in some cases, where the solution of carbonate ammonia was applied, the plants grew most luxuriantly ; but, in all cases, where the quantity of salts equalled 1-30th part of the weight of water, the effects were injurious.”

Some of our writers have supposed, that the more simple manures, which act in small quantities, such as

gypsum and all the saline substances, act in the vegetable, in the same manner as condiments and stimulants do in the animal economy, and that they render the common food more nutritive.—Sir H. Davy says, it seems a much more probable idea that they are actually a part of the true food of plants, and that they supply that kind of matter to the vegetable fibre which is analogous to the bony matter in the animal structure. It appears, then, by this theory, that salt is undoubtedly an ingredient in the soil, but what quantity should be applied, or when necessary, or if any, seems to depend upon different circumstances.

The soil may be impregnated with salt in various ways. More or less is always conveyed to the land in the dung; and when soils are situated on sandstone rocks, they are impregnated with salt, and probably many other of the soils contain a sufficient quantity for all vegetable purposes; and in that case, a further supply of it might not only be useless, but it might be injurious to the soil, even if applied in small quantities.

Mr. Naismith is of opinion, there is no danger to be apprehended from any of the acids in the soil, when they are disengaged from the metallic acids; and he further says, neither can salt continue long in the land, as from its easy solubility, it is liable to be washed away by the first heavy rains that fall. But we have heard of the banks of salt water rivers being broken down or flowed over, and of the flooded land being injured for years afterwards. As the case now stands, therefore, between theory and practice, it ap-

pears too hazardous a speculation to recommend the application of common salt as a manure, though there appears a probability that it may not only be an useful ingredient in the soil to vegetation, but it is also probable, that it may yet be proved to be a necessary ingredient to the support of some plants.

It has been said, that the sun-flower will not flourish except saltpetre is present in the soil.—I have proved by some soils that I have lately caused to be analyzed, that when gypsum was not present, the plant of red clover died, when it should have formed the stalk.—Chalky and flinty land produces a firmer and a better polished straw, than the loamy or sandy soils ; and there can be no doubt that some particular unknown cause exists to make that distinction, although that cause, to my knowledge, has never yet been explained.

Salt will destroy snails, worms, grubs, and caterpillars. If a grain of salt be let fall on the back of a snail, that spot immediately changes colour, and the body of the snail is converted into a shapeless mass of blubber ; and if a number of grains be strewed on some of the soft skinned reptiles, it is always present death to them. Here then, we find that salt can be usefully employed when it can be brought in contact with reptiles.—Worms, it is said, feed on carbon, or the food of plants ; if that be the case, and salt is applied to the soil, by destroying the worms it would answer a two-fold purpose, by converting a destroyer of food into an immediate food for those plants.

The salts which have been supposed to promote vegetation or fertility, according to Holme, are sulphate of potash, the nitrate of potash, the sulphate of magnesia, the nitrate of lime, and the sulphate of soda.

The saline substances that have been supposed to be the cause of sterility in soils, as mentioned by Mr. Young, are the vitriolic acid, (probably the sulphate of iron,) Holme says, the salt of steel ; and Headrick, martial pyrites.

Dr. Saussure's experiments shew that the ashes found in plants are similar in constitution to the soil in which they have vegetated. He caused plants to grow in solutions of different salts ; and he ascertained, that in all cases certain portions of the salts were absorbed by the plant, which he found unaltered in their organs.

Sir H. Davy says—"even animals do not appear to possess the power of forming the alkaline and earthy substances."—Dr. Fordyce found, that when canary birds, at the time they were laying eggs, were deprived of access to carbonate of lime, their eggs had soft shells ; and if there be any process for which nature may be conceived most likely to supply resources of this kind, it is that connected with the reproduction of the species.

"As the evidence on the subject now stands, it seems fair to conclude that the different earths and saline substances found in the organs of plants, are supplied by the soils in which they grow ; and in no cases composed by new arrangements of the elements

in air or water. What may be our ultimate view of the laws of chemistry, or how far our ideas of elementary principles may be simplified it is impossible to say. We can only reason from facts. We cannot imitate the powers of composition belonging to vegetable structures; but at least we can understand them: and, as far as our researches have gone, it appears that in vegetation compound forms are uniformly produced from simpler ones; and the elements in the soil, the atmosphere, and the earth, are absorbed and made parts of beautiful and diversified structures.

The views which have been just developed, lead to correct ideas of the operation of these manures, which are not necessarily the result of decayed organized bodies, and which are not composed of different proportions of carbon, hydrogen, oxygen, and azote. They must produce their effect, either by becoming a constituent part of the plant, or by acting upon its more essential food, so as to render it more fit for the purposes of vegetable life.

The only substances which can with propriety be called fossil manures, and which are found unmixed with the remains of any organized beings, are certain alkaline earths, or alkalies, and their combinations. The only alkaline earths which have been hitherto applied in this way, are lime and magnesia. Potassa and soda, the two fixed alkalies, are both used in certain of their chemical compounds."

We are informed by theorists, that where alkalies come in contact with any refractory substances, they

act as solvents ; and all saline properties, whether vegetable or mineral, when in the soil, attract and contain moisture : all plants produce natural salts or compounds analogous. The following table, is selected from M. Th. de Saussure's *Researches on Vegetation* ; it contains seventy-five different experiments, made by that Philosopher ; and exhibits the quantities of soluble salts, metallic oxides, and earths, afforded by the ashes of the different plants.

Selected from M. Th. de Saussure's Tables.

Names of Plants.	Ashes from 1000 parts of the Plant green.	Ditto, dry.	Water from 1000 parts of the Plants green.	Constituents of 100 pts. of ashes					
				Soluble Salts.	Earthy Phosphates.	Earthy Carbonates.	Silica.	Metallic Oxides.	Loss.
36 Plants of peas, in flower or ripe	—	81	—	34,25	22	14	11	2, 5	17,25
38 Plants of vetches, in flower, June 23	20	122	876	55, 5	13, 5	4,12	1, 5	0, 5	24,38
42 Ditto, in flower, raised in distilled water ..	—	39	—	60, 1	30	—	—	0, 5	9, 4
52 Wheat, in flower, June 14	16	54	699	41	10,75	0,25	26	0, 5	21, 5
54 Straw of wheat	—	43	—	22, 5	6, 2	1	61, 5	1	78
55 Seeds of ditto	—	13	—	47,16	41, 2	—	0, 5	0,25	7, 6
56 Bran	—	52	—	4,16	46, 5	—	0, 5	0,25	8, 6

Pounds per Acre.

Pounds.								
36	Five lb. per square yard	1960	670	431	274	215	49	317
37	Five lb. ditto.....	2950	1637	398	121	44	14	748
52	Ditto	1306	537	140	3,2	339	0,65	278
54	Thirty cwt. per acre.....	181	4,07	11,2	1,81	111,3	1,81	159
55	Seed, 27 bushel, 60lb. per bushel	21	9, 8	9,2	—	1	52	1,59
56	Bran, 12lb. per bushel	16	7,	7,3	—	8	4	1, 2

Ashes per Acre.

	<i>C. gr. lbs.</i>		
36 Peas 5lb. per square yard,	17	2	0
37 Vetches, ditto,	26	1	12
52 Wheat in flour, 5lb. per yard, June 14,	11	2	18
54 Straw of wheat, 30 cwt. per acre,	1	1	14
55 Seed of ditto, 27 bushels, 60 lb. per bushel,	0	0	21
56 Bran, ditto, 12 lb. per bushel,	0	0	16

These tables shew us the different properties that plants produce when put under a chemical process; and by which it appears, that all earthy ingredients are taken into the system of plants by the roots; and here is another display of Divine goodness, in protecting that most important vegetable, the wheat plant, against weeds and insects; for if we examine this table minutely, we shall find that both grain and straw are protected, as it were, by a coat of mail, for the metallic oxides are chiefly found in the bran and chaff, and the siliceous earth principally in the straw. In all cases, some of the earths in which plants grow, are taken into the system by the fibre with their food, if it be necessary to the growth of the vegetable; and Sir H. Davy says—“It is for the purpose of giving hardness and firmness to its organization. Wheat, oats, and many of the hollow grasses have an epidermis, principally of siliceous earth, the use of which seems to be, to strengthen them and defend them from insects and parasitical plants.”

The gypsum found in the ashes of sainfoin and clovers, is also taken up from the soil with the fibres, and this in course must be with their food, and forms the woody fibre of the stalk; this accounts for the plant becoming sickly, and the total disappearance on those

that do not contain gypsum ; and this too appears to be about the time the plant begins to form for putting up their stalks or woody fibre stems. All plants take up some of the earths they grow in, but in no instance do we hear of their becoming exhausted of any particular earth except gypsum.

We are told by the ingenious Tull, and probably with great truth, that the same food is applicable to all plants, or, “that plants of the most different nature feed on the same sort of food, and that a soil which is proper to one sort of vegetable once, is, in respect of the sort of food it gives, proper for it always.” This position is known to be true : for if land become exhausted of its vegetable and animal matter, it ceases to grow good crops of any sort, be its mixture of the earths ever so intimately and evenly divided. We also know that vegetable and animal manure alone will not render all steril and infertile land fruitful ; but a due mixture of the earths, with lime, gypsum, &c. together with animal and vegetable matter, and good tillage, will render any dry land fruitful. Though plants do take earth into their system, we must not suppose, as Tull did, that it is the food upon which they live, so as to grow to any size. But from what has been said, we may conclude, that oleaginous or glutinous earths, form a part of the system of plants, such as the seeds, which produce oil, or the stem and oily fibre, or a glutinous epidermis ; but the health and vigour of cultivated plants, must depend on the quantity of putrescent matter the land contains, with

a due proportion of tillage ; and even then they must depend on the season for a necessary supply of moisture and warmth. It must be admitted, however, that adequate or good tillage, has a great effect on all soils, in encouraging the growth of vegetables, but this effect should be attributed more to the soil having been prepared by the tillage, to absorb, hold, and regularly impart to the plants that moisture as they require it, than to what the above writer laid down, when he stated that pulverization or a fine division of particles was every thing ; yet, for barley and small seeds, land cannot be too much pulverized.

All soils growing winter crops, such as vetches, rye, Italian ryegrass, winter barley, or stubble turnips, are improving by the winter atmosphere and are becoming better prepared for a succeeding crop, than if they lay unploughed through the winter. In fact, there is no land on a tillage farm that should not be planted with some crop or other before winter, except that intended for beans, or spring cabbage ; even these might be sown with rape, turnips, or some vegetables, and be off the land time enough for planting cabbage.

The principle errors which the ingenious author of the "Drill and Horse-hoeing Husbandry" fell into, seem to have arisen from his deficiency of chemical knowledge, or rather from the want of that assistance which he might have derived from it, had he been better acquainted with that science ; for at the time he wrote his able Treatise, the different elements of the atmosphere, and the different gases that the earth contains,

were not known ; but his ingenious mode of culture, his shrewd observations on the progress of vegetation, have led to many important discoveries, both in chemistry and practical husbandry. In the absence of the above knowledge, it was much more rational in Tull, to attribute the sole food of plants to earth, than it was, in the other great philosophers, to imagine that they existed on air alone, or on water only, while in fact, it appears that neither one, nor all combined, are the immediate food of plants, but they are all necessary agents in the manufacture, as it were, and preparation of food. The earth, is the laboratory for their roots and the depository for their food—the air, the vehicle of conveyance—and water, the administrator—heat also, is an agent in the work, but like air, an invisible one.

Tull's success in growing good crops on impoverished land, without the assistance of dung, ought in part, to have been attributed to deep ploughing, and bringing up fresh earth, and raising the staple of the soil by his twelve-foot ridges, which formed a part of his grand system ; reversing them alternately from ridge to furrow, and planting the ridges only, leaving the wide space for ploughing, or what he termed horse-hoeing. Although his method encouraged and admitted the fibres to extend over the whole space for their food, his crops could not have been supported for sixteen years in succession, without the application of manure, had there been no putrescent matter formed as food for the plants, than the stubble and their roots.

But he says, before he began his drill system, his

farm was stocked with charlock, poppies, and other seed weeds ; and this alone, would account for his crops being supported, for they would answer the purpose of any other green crop being ploughed under furrow.

All plants, both large and small, require food from the earth, and a sufficient space in the atmosphere, to extend their branches, but all the room, beyond a proper space, is a waste of land ; and though Mr. Tull's crops might have been great, when compared with his neighbours, whose farms like his own were overrun with weeds, yet they could not have borne a competition with good crops of the present day. But I need not take the trouble to combat a system that has been long exploded ; the rows were much too wide for any crop,—and dung was indispensable ; and it has also been since established, that full smothering crops act as manure to the land, and are also a good substitute for fallows. Time has also proved, that the principal advantage to be derived from drilling, arises from depositing the seed regularly at a proper depth, and by admitting the use of the scarifier and hoe.

The farmer, it is said, to arrive nearer to perfection, must imitate the garden culture. It is not a general custom with the gardener, to row all their small plants ; but, I have no doubt, the system has its advantages in all crops, whether they are grown in the garden or field. The gardener, whether he sows his seed at random or in drills, is always careful to keep his seed near to the surface ; air is as requisite for a quick and

strong germination as moisture, and to this the farmer is not so attentive as he should be, and often drills his seed too deep. The gardener, too, frequently double digs his ground, still keeping the surface soil on the top; and the farmer has the means of possessing himself of the advantages which this process would afford him, by trench-ploughing, or by a method more simple, that of fixing a share immediately behind the plough, and cutting under the furrow last turned; he may set this share to cut from two to four inches deep, or more, if the land be free from roots and large stones; there is then no obstruction, and it only requires care in the boy who holds the plough, to throw the share out, and bowl it round at the land's end. The extra draft is very trifling; the share should be composed of the best steel, and made thin and sharp.

While speaking of the garden system, I cannot but remark, that the horticulturist, in the management of his ground, falls into an absurd error, and continues year after year, to commit the same fault, not because he is supported by reason, but that he is sanctioned by custom. In the first place, the gardener fancies his land cannot be made too rich with dung, and he carries into his garden large quantities of the strongest animal dung he can find at the stable or ox-stall doors, and by this fetid odour, he impregnates his vegetables with so much hydrogen gas, that the very water in which they are boiled, fills the whole building with a most disagreeable stench.

Secondly, he places but little dependence, if any

as a manure, on the effect of lime. Gardens that are dunged to excess, more than any other land, will bear and require the greatest quantity of calcareous earths to carbonate the gas. Gentlemen and others, living in large towns who from their wealth, have the means of procuring all the luxuries the land can produce, frequently do not know the taste of a good turnip or carrot, because the land lying round large towns, is rendered unfit for the growth of sweet esculent vegetables, by the quantity of animal dung and other fetid matter, that is applied to it. If the gardener would be more sparing of the dung, and use more lime, the evil would be remedied. I do not know of any better way of growing sweet good-flavoured turnips, than by fixing upon an airy spot in the garden, dividing it into three beds, and appropriating them entirely to the growth of turnips, for consumption in May, June, and July; when the ground might be dug again and sown for a winter's crop. If the gardener would leave off using animal dung, and dress the beds occasionally with fresh soil, or lime compost, he may generally have fine flavoured turnips, almost every month in the year.

Vegetables of the quickest growth, are said to be the tenderest when dressed, and thence they should have dung to force them; but it should not be forgotten, that hoeing and plenty of water in a dry season, are a substitute for manure. Dung, it must be allowed, increases the quantity of any sort of vegetables, but when the garden requires manure, that

made from vegetable matter, is by far the most preferable for esculent plants.

Stubble, or long straw dung, is said to encourage a greater yield of potatoes on some sorts of land, than short fermented dung. The flavour of the potato is better preserved by keeping it in the ground it grows in until it is wanted for use ; but they must be covered with litter, dung, or stubble, to preserve them from the frost. Land that is suitable to potatoes, and has grown them once, will always grow them of the same flavour under similar circumstances. Land never tires of growing the same species of weeds, nor will it be of growing cultivated plants, where the soil and climate are congenial to their production ; and there is no other reason than what I have named above, for changing the species.

Let the gardener, who has any doubt of the result of the above statements, try his own experiments, by taking off a good digging from the surface of his rich over-dunged ground, sufficient for three small beds ; dig and pulverize the sub-soil, and mix into it as evenly as he can, a dressing of lime ; plant one with carrots, another with cabbage, and the third with turnips, and then compare the flavour of each against those grown on his rich over-dunged land. But this will not be a fair experiment, unless the rich soil be removed far enough from the beds, so that the fibres of the plants do not extend themselves into it.

Green vetches are an excellent manure for potatoes. The method is to fix on a favourable soil and

plant it in succession, alternately with potatoes and vetches. The potatoes are forked up in October, and the vetch drilled immediately the refuge is moved off. This crop is ploughed or dug in at the latter end of May, or first week in June, and planted with potatoes for winter consumption. This method has been practised at my recommendation, on many of the cottage allotments, and has never failed to produce a good crop, with little or no other manure.

It may not be generally known, that potatoes will keep as free from sprouting and retain their flavour for twelve months, if secured from moisture and air—the camp should be made in a shady place, sheltered and free from the wind.

TABLE OF THE QUANTITIES
OF SOLUBLE OR NUTRITIVE MATTERS AFFORDED BY
ONE THOUSAND PARTS OF DIFFERENT
VEGETABLE SUBSTANCES.

Vegetables or vegetable Substances.	Whole quantity of Soluble or Nutritive Matter.	Mucilage or Starch	Saccha- rine matter or Sugar.	Gluten or Albumen.	Extract or matter rendered insoluble during evapora- tion.
Middlesex wheat, average crop,.....	955	765	—	190	
Spring wheat,	940	700	—	240	
Mildewed wheat of 1806	210	178	—	32	
Blighted wheat of 1804,..	650	520	—	130	
Thick - skinned Sicilian wheat of 1810,	955	725	—	230	
Thin - skinned Sicilian wheat of 1810,	961	722	—	239	
Wheat from Poland.....	950	750	—	200	
North American Wheat,..	955	730	—	225	
Norfolk Barley,	920	790	70	60	
Oats from Scotland,	743	641	15	87	
Rye from Yorkshire,	792	645	38	109	
Common bean,	570	426	—	103	41
Dry peas,	574	501	22	35	16
Potatoes,.....	{ from 260 to 200	{ from 200 to 155	{ from 20 to 15	{ from 40 to 30	
Linseed cake,	151	123	11	17	
Red beet,	148	14	121	13	
White beet,	136	13	119	4	
Parsnip,	99	9	90		
Carrots,	98	3	95		
Common turnips,	42	7	34	1	
Swedish turnips, ...	64	9	51	2	2
Cabbage,	73	41	24	8	
Broad-leaved clover,	39	31	3	2	3
Long-rooted clover,	39	30	4	3	2
White clover,	32	29	1	3	5
Sainfoin,	39	28	2	3	6
Lucern,	23	18	1	—	4
Meadow fox-tail grass, ..	33	24	3	—	6
Perennial rye grass,	39	26	4	—	5
Fertile meadow grass,	78	65	6	—	7
Roughish meadow grass, ..	39	29	5	—	6
Crested dog's-tail grass,..	35	28	3	—	4
Spiked fescue grass,	19	15	2	—	2
Sweet-scented soft grass, ..	82	72	4	—	6
Sweet - scented vernal grass,	50	43	4	—	3
Fiorin,	54	46	5	1	2
Fiorin cut in winter,	76	64	8	1	3

*The Quantities of soluble or nutritive matter, per
Acre, selected from the last Table.*

Vegetables or vegetable substances.	Whole quantity of soluble or nutritive matter.	Mucilage or starch.	Saccharine matter or sugar.	Gluten or albumen.	Extract or matter rendered insoluble during evaporation
	lbs.	lbs.	lbs.	lbs.	lbs.
Middlesex wheat, 27 bushel per acre, weighing 60 lb. per bush.	1547	1242	....	305	....
Spring wheat, ditto, 67 lb. ditto.	1272	1021	....	251	....
Barley from Norfolk, 5 quar. per acre, weighing 50 lb. per bush.	1840	1580	140	120	....
Rye, 30 bushel per acre, weigh- ing 56 lb. per bushel,	1330	1083	64	183	....
Oats, 48 bushel, weighing 40 lb. per bushel,	1426	1230	29	167	....
Potatoes, 400 bushel per acre, weighing 56 lb. per bushel, ..	4480	3472	336	672	....
Common turnip, 20 ton,	1881	313	1525	45	....
Swede turnip, ditto	2867	405	2284	89	89
Cattle cabbage, 30 ditto	4905	2755	1612	538	....
Mangel-wurzel 20 ditto	6630	627	5420	583	....
Red clover, 20 ditto	1747	1388	133	89	135
Sainfoin, 15 ditto	1310	940	67	101	202
Lucern, 30 ditto	1545	1209	....	67	269

All these substances, were submitted to experiments green and in their natural states. It is probable that the excellence of the different articles, as food, will be found to be, in a great measure, proportional to the quantities of soluble or nutritive matters they afford; but still these quantities cannot be regarded as *absolutely* denoting their value. Albuminous or glutinous matters, have the characters of animal substances; sugar is more nourishing, and extractive matter less nourishing, than any other principles composed of

carbon, hydrogen, and oxygen. Certain combinations likewise, of these substances, may be more nutritive than others.

The reader will observe, the last tables are selected from Sir H. Davy's Table of Experiments, for the purpose of shewing a comparative view of the soluble or nutritive matter each species of plant affords per acre. The gross produce is assumed from the best light land, or from such as will produce ten tons of potatoes per acre, under good management, and here we find an acre, taking them to afford 200 parts in a 1000 of soluble or nutritive matter, to be nearly three times the quantity an acre of wheat or other grain affords. But Sir H.'s experiments, seem in some instances, to have afforded 260 parts in a 1000, this is considerably more than three times the quantity of nutritive matter that an acre of grain produces. We also find by the same table, that potatoes produce one-fourth more soluble matter than linseed cake; and mangel-wurzel affords nearly as much in a given weight. Indeed, linseed cake seems to be a very extravagant food for fattening cattle, compared with many of the vegetables or roots. And potatoes appear to be the most economical for fattening of pork, where there is a conveniency for cooking them. We also find, by these tables, that lucern is more deficient in its nutritive properties, than any other of the vegetables. So that its perfections seem to be in its long continuance in the land, its early growth in the spring, and from its being a deep rooting plant, it is not affected so much by extreme drought, or other vicissi-

tudes of season ; and like other plants that have a tap root, must take a part of its nourishment from the sub-soil, but its comparative value, will be better seen in the following pages, where the expenses of raising and attending each crop, are shewn.

It is now upwards of a century, since the celebrated Jethro Tull published his Treatise on Drilling and Horse-hoeing ; and though both theory and practice at that time gave every prospect of its success, yet it can hardly be said to have become the established custom in every part of the country, even at the present day. But this, like all other new discoveries, required time and experience to improve both the implements and practice ; and, notwithstanding the long lapse of time, it is not yet determined what is the proper interval to be left between the rows of each species of plant, and the proper and most efficient instrument for hoeing that interval. As soil and season both vary so materially, perhaps no definite space can be fixed upon, that would suit each variety in all situations ; so that each farmer, generally, must be guided by his own judgment and experience in each particular case, taking for his guide, the success he has had on the average of preceding seasons. Losses have often occurred from being too sparing of seed, and leaving the space between the rows too wide. All sorts of crops, when at their full growth, should completely cover the ground, though every farmer knows he may have too much as well as too little straw. As manure and mechanical labour, are both improvers of the soil, the deficiency

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of the former, may in some measure, be made up by the latter : but much depend, on deep hoeing, and in performing the labour at a proper time ; for if the season has been such as to cause the land to fall, the scarifier should be used before the soil becomes too dense.

The agriculturist, I have just referred to, has said in his Treatise, that manure in soils acts only as a pulverizer, and that dung may be dispensed with ; but he could not have been aware at that time, that it furnishes food for plants, as well as pulverizes the soil. He also says, that mechanical labour is cheaper than dung ; without noticing that the latter is a permanent, whilst the former is only a temporary improvement ; and that the more land is stored with manure, the less mechanical labour is required in each process of tillage ; and that those crops which take intervals of eight, ten, or twelve inches only, if the land be in good condition and the seasons favourable, need no additional expense, except weeds appear after the seed is deposited and covered. But there can be no doubt, that such plants as require fourteen, eighteen, twenty-seven, or thirty inches space, are augmented in size, and the crop increased in bulk, by stirring the soil at proper periods.

CHAP. XX.

ON AN EIGHT-COURSE CROPPING — VARIOUS WAYS
OF CULTURE AND MANURING — USE OF GYPSUM
IN GROWING RED CLOVER — SIR H. DAVY AND
A. YOUNG, ON GROWING GREEN WINTER CROPS
— ON TARE-CULTURE — EXPERIMENTAL REMARKS
ON THE GROWTH OF LUCERN.

THE former comparative systems, are chiefly intended to shew the difference of profit.

Amongst the numerous other methods, I select the following, as one that has some advantages over the heavy and tender clay soils; but perhaps, it is not altogether so practicable, in particular seasons, as the former rotation, in pages 106 and 107. Neither can I recommend it in preference to the former on land out of condition.

First clover—2d wheat—3d cabbages—4th oats, or barley, or spring wheat—5th beans—6th wheat—7th vetches—8th barley.

These eight crops, if the vegetables and straw be spent in the stable and fold-yard, will raise dung enough for three of the green crops; and lime or com-

post, or other foreign manure, should be provided for the fourth green crop.

I have before said, that cabbages ought to form a part of the economy in tillage, on all tender or damp soils; but in order to remove any prejudice that may exist on the subject, I shall begin with the first crop, and explain the whole of the processes; but here, let it be understood, that I am speaking to those who have had little or no experience in these matters.

Formerly, clover was estimated as one of the most profitable crops on all kinds of land. It has, however, latterly failed in producing a crop; but when it has been sown no oftener than every eighth year, it has seldom failed of producing a heavy crop, and has always been found to leave the ground in an excellent state for wheat. The principal objection to this husbandry, on the heavy land, has been the difficulty in ploughing and working the ground, and this may have been the case in some instances, where the red clover has not produced a full crop. But as we may now invariably calculate upon having a full crop of that plant, and by mowing instead of grazing it, no difficulty in any season, can much impede the working of the land, with the present improved ploughs, rollers, &c. If the land prove ever so wet, it may be planted or dibbled, or if the season should be more than usually dry, the cutting or spike-roller put across the land as it is ploughed, will break the clods sufficiently small for the harrows or dibbles to work, if not the drill.

I shall now endeavour to shew, and I trust satisfactorily, how a full crop of cabbage may be raised, I say a FULL CROP ; but let it be understood, the farmer ought not to be satisfied with less than a full crop, in all cases.

Cabbages, we know, are grown upon all kinds of soil, from the blowing sands to the glutinous waterproof brick-earths. The great difficulty arises in raising this plant on the strong soils ; they must be well pulverized, and this will much depend on early ploughing. The sooner the land is ploughed after the wheat crop is carried off the better. No manure is lost by ploughing in stubbles ; that, as well as early ploughing, has a good effect upon the land, and it saves mechanical labour in the spring.

All land ploughed in the autumn, should be turned up the full depth that the soil will admit, but clay land is often ploughed too wide to admit of the full effect of the winter's operation.

“Early ploughed land attains a consistency better adapted to the purposes of vegetation than mechanic labour can bestow. It does not easily yield up its water to exhalation ; and it gives the most commodious reception to the roots of vegetables.”—*Naismith*.

The quantity of mechanical labour in the spring, will much depend on the effect the autumn and winter atmospheres have had on the land. The dung should be carted and ploughed in as early in the spring as the land will carry the horses. If it be green, the fermentation will have a good effect in assisting to break the

tenacity of the soil ; two ploughings may be required, or perhaps one may do, with rolling and setting up the ridges.

Some agriculturists, who have inclined to the row or ridge-culture, have recommended the practice of not applying the manure until the land is prepared to set up the ridges, but I have generally had the greatest produce, by putting the dung on in the common way, and mixing it well with the soil in working. When cabbages are planted in May, or the beginning of June, they should be set on ridges, from 30 to 36 inches from each other, and the plants should be two feet asunder in the row ; which will require about 7000 plants or upwards to an acre. This is a commodious width for ploughing between the rows. The first process should be to turn two furrows from each of the rows each way. The second, should be to turn them back again, either with the double-mould, shelve-board, or the common plough, but the latter performs the work best. Hand-hoeing and hand-weeding, perhaps, may be necessary afterwards.

As carting on this sort of land injures the succeeding crop, the cabbages may be carried to the head-land in baskets. I have heard of a crop of the large cattle cabbage, planted early in spring on this kind of land, producing 40 tons per acre.

I once grew a prodigious crop of cabbages upon light land, where I applied not more than half a dressing of dung, and about twenty-five bushels of horn-shavings per acre. They were grown on ridges after

the Northumberland method, and were computed at more than forty tons per acre.

I shall now proceed to make some observations on the tillage, which I consider to be the most precarious, and not the least important part of this subject. Oats are considered to succeed on inferior land, and with a worse tillage than barley. The white clays and the thin-soiled tenacious land, are those which become most dense in the winter, and dry into clods in the spring, so hard that it often requires much mechanical labour to break them; which it must be expected, to be the case here. But, the dung being fresh in the land, and the tillage which it receives while the cabbages are growing, will both unite to facilitate the working of it in the spring. Still some difficulties will present themselves in either particularly dry, or in very wet seasons, which is the case, more or less, on all soils; and all I can do is to point out those instances in which I have been successful in my own practice.

I should first observe, that where the ridge-system has been the last process, whether for cabbage or turnips, the land will require some extra mechanical labour to obtain an even surface, and to mix the manure more regularly with the soil. This operation is best effected with the light iron-plough, having an expanding mould-board, by setting it to the widest expansion in the hollows, and contracting it to its narrowest limits on the ridges. I have previously observed, that the ridges should be ploughed as narrow as possible, which will both prevent the adhesion of

large clods and facilitate the working of the land. If the land be dry, the roller and scuffle will be the most effective implements that can be employed to level the surface and mix the manure with the soil. A season has frequently been lost on tender land by waiting for dry weather to work it. An early seeding often proves of more advantage than a fine tilth, and dibbling or planting may, in many instances be effected, when neither the harrows nor the drill can work.

Cabbage-stalks are a strong manure, but they require a long time to decay and become soluble. When they are dug up, they should be carted to the compost heap and some soil thrown upon them; all refractory matter, such as clippings of hedges, the scouring of ditches, roots of grass, or dead scouch, all make good compost, when rotted. It is a custom with some farmers, to burn such refuse, but the alkali produced, is but of little value, compared with the ammonia or other compounds they afford, when rotted down in the heap. As I have often hinted at the neglect of the farmer not attending to the quantity and quality of manure, I shall here observe, the great advantages there is in having a proper receptacle for making of compost; if possible, it should be near or below the farm-yard, where the drainings from the yard can be turned upon it occasionally; the bottom and sides of the basin or cess-pool, should be made waterproof and have a communication from the cistern that receives the soakages of the different yards; if no cistern is already made, one ought to be, with drains to receive

such drainings, and if convenient, the cistern and compost basin should be near to each other, so that the sediment of the soakage might occasionally be thrown over the compost heap.

Beans, the next crop in succession, are cultivated by a very simple process. They affect all kinds of heavy deep soils, and it is a favourite crop for the employment of manure. This plant receives support from the atmosphere, in proportion to the strength of the stem and the quantity of leaves that it produces. The same process that has been recommended in the culture of cabbages, should be adopted for this crop; and the dung should be put on the land and ploughed in as soon after the oat crop has been cleared off, as may be done with convenience to the farmer.

Of the proper distance of the rows, as well as of the best method of planting beans, there are various opinions. Some prefer the drill, while others dibble in, or plant the seed; and while some set the rows at nine inches, others plant them twelve inches apart. But that the distance of the rows, as well as the quantity of seed, should be varied according to the state of the land, cannot with any one admit of a single doubt; and when the land is full of animal and vegetable manure, or the straw is expected to grow strong, wide rows, probably will produce the most corn.

One of the best bean crops that I ever grew, was by planting the seed in rows, alternately, of nine and eighteen inches wide. The seed was dropped by women and children, in the seam of the plough-slice or

furrow, and covered by men who followed with hoes. This method has two great advantages over many of the other methods now in practice. First, it raises a greater depth of soil where the plant grows, and in the next place, the eighteen-inch or two-furrow space, admits of the horse-hoe or the Kentish-skim, to act upon the land.

Wheat is the next crop, and the culture of this invaluable plant must invariably depend on the season and nature of the land. The manure employed in the last crop, will be a good preparation for the succeeding one, so that whether the seed be drilled or dibbled by hand, there can be but little danger of having a good crop after one ploughing.

Vetches, which forms the third and last fallow-crop in the course, requires nothing more from the cultivator, than the application of the dung-fork, laying on the manure, ploughing, and putting in the seed.—Winter vetches should be sown at different times from August to November, and if they are intended to be eaten off early in the spring, a little rye should be drilled in with the seed. If the crop is soon eaten off, and not bitten too near the ground, they will produce a second crop; but they afford but little keep when eaten before the tendrils meet, The vetch is a plant that grows very fast when the tops begin to meet. Vetches are in the highest perfection for sheep and cows when they are in blossom, but horses thrive the best on them when they are in pod. The crop should always be cut in lands, so that the plough may go to

work immediately after the crop is taken off, for if the land is suffered to dry before it is ploughed, much more mechanical labour will often be required to work and clean it. This is the best preparation for barley within my knowledge, and there is but very little land, if any, that will not grow a crop of that corn after a vetch-fallow, if properly managed.

If the land be too tender for turnips or rape, it should be ploughed with a bold rib-furrow, and the trenches kept open to take away all superfluous water. When the land is thoroughly dry in the spring, the scarifier, on most kinds of land, will probably be the most efficient implement to work it, as it will leave the pulverized soil on the surface.

Clover, which is the last crop in the course, should be sown in the common way with the barley. If the land had not, before the commencement of this course, failed to grow red clover, there will be no occasion to supply it with gypsum; but if it had previously ceased to grow good crops of that plant, a certain portion of that article should be applied to the soil. The quantity which it will now be proper to use, seems to depend on what portion the soil already contains, and what quantity it may have obtained by the common course of manuring which it has since undergone, as all dung contains some gypsum. But where the soil has been entirely exhausted of that substance, by the growth of artificial grasses, art and industry should be employed to supply the deficiency. From the experiments which I have made myself, and from

those which I have caused to be made by others, I should suppose there is no land that will require more than from three to six bushels per acre. Where the land has not wholly refused to sustain a red clover crop, and the plant began to disappear only in patches, (which is an indication that the gypsum in the soil was nearly exhausted,) six or eight bushels of well-pulverized gypsum per acre, applied to such fields, would grow, and probably continue to grow, under any of the common modes of husbandry, good crops of red clover for a series of years. Deeper ploughing than ordinary, in such cases, as I have before observed, has sometimes a good effect.—Gypsum may be procured at any of the drysalter's, in the shipping towns.

I shall here quote an instance, applicable to this subject from Arthur Young's Register:—"The unfortunate circumstance which attends clover, is its being extremely apt to fail, in districts where it has been long a common article of cultivation. The land, to use the farmer's term, becomes sick of it. After harvest, he has a fine plant, but by March, or April, half or perhaps more of it, is dead. This makes a new course of crops necessary. Instead of its occurring once in four years, as in the common Norfolk course, it becomes necessary to sow it only in the second round; alternately, beans after barley in one course, and then clover in the next. This has been found to answer.

"The observation, however, should be made not without remarking, that on a farm at Morden, in Sur-

rey, Mr Arbuthnot, by means of deeper ploughing than common, and ample manuring, succeeded well with clover every third year in this course :—

1. Beans,
2. Wheat,
3. Clover,

on land that was said to be sick of it though sown before only once in four years. I viewed his crops in that new course, during three rounds, and never saw finer.”

Here is another proof of what may be done by gypsum. Three of the most profitable crops that can be grown on land, are found to be good in succession : but I cannot think that this course, if it were desirable, is practicable, excepting on the best clay loams, and then they must be in the highest state of condition.

It is extremely probable, that gypsum may have a tendency to sink into the sub-soil, and that the land, in the instance alluded to above, as well as in many others, may contain its own resources, but the surest method is to procure the article and apply it to the surface soil.

It is one of the most simple processes in chemistry, to prove whether soil contains gypsum, or what proportion. Sir H. Davy, in page 157,—says, should sulphate or phosphate of lime be suspected in the entire soil, the detection of them requires a particular process upon it. A given weight of it, for instance, four hundred grains, must be heated red for half an hour in a crucible, mixed with one-third of powdered charcoal.

The mixture must be boiled for a quarter of an hour, in half-a-pint of water, and the fluid collected through the filtre, and exposed for some days to the atmosphere in an open vessel. If any notable quantity of sulphate of lime (*gypsum*) existed in the soil, a white precipitate will gradually form in the fluid, and the weight of it will indicate the proportion.

It appears, from the analyzation of soils, that two grains in 400, that is, if the soil contains one part in two hundred, that may be considered as much gypsum as is requisite to support a crop of red-clover.

As I have Arthur Young's Calendar before me, I shall quote a few sections from that work, which I conceive to be analogous to the course of cropping, of which I have last treated. He says—The cabbage planted in April will require hand-hoeing in May. It should be given only to the tops of the ridges, about eight or nine inches around the plants : the weeds should be cut up clean, and loose mould drawn to the stems of the plants. In about ten days after, the first horse-hoeing should be given, turning a furrow or two from the plants, and throwing up a ridge of earth in the middle of each interval. This operation will be of great use : it lets the atmosphere into the ridges on which the plants stand, and consequently sweetens and meliorates the soil ; and it kills the weeds that grow on the sides of the ridges much cheaper than it can be done by the hand-hoe : it likewise pulverizes the earth taken away, and brings it into fine order for returning to the plants in June, when they will strike into it, and thrive the more.

No farmer can entertain too high sentiments of the necessity of gaining crops of green winter food : the importance of having such food for his cattle, and not depending on hay, is one of the clearest axioms in the whole range of husbandry. His profits will be amazingly lessened ; his loss in the want of manure, felt severely for many years, and on farms not abounding with hay, his expense in buying it, or his loss in selling his cattle, will be equally great. But, besides these accumulated evils, there is another of a different nature, which he should consider well: it is the change of his course of crops. After either turnips or cabbages, he sows spring corn, and with that spring corn, seeds. On some soils, the grass is left but one year, in others two, and in others mixed with ryegrass, &c., longer.

The ley is ploughed up, and corn at once planted. This is compendious, cheap, and yet excellent husbandry ; for the duration of the grass, is a constant fund of profit, at scarcely any expense, and the preparation for corn is carrying on in the most beneficial manner. But if turnips fail, cabbage should be planted, or what is the consequence ? Why, the farmer sows wheat on the fallow, in hopes of a good crop, to pay him for so much tillage as the land has received. The introduction of that crop, at once breaks the whole arrangement of his farm, and he is forced to begin again, or to pursue that pernicious husbandry of sowing two crops of white straw running. He must either fallow for turnips again, or take a crop of barley and then turnips : thus he is thrown out of his clover, though

as important a crop as any on his farm, and launches into a series of tillage, that cannot but prove very expensive to him, without repaying the benefit that the clover-course would have done.

For these reasons, when the turnips fail, and cabbage are not planted, the land should be laid up in winter for barley, and the clover sown with it, which will turn out far more profitable than throwing in wheat.

The best season in the year to sow winter vetches to stand for seed, is in February : there is less danger then of the plant being injured by the frost, and consequently less seed will be required. They will not run so much to straw, but they generally produce more corn than when they are sown in autumn.

Spring tares (vetches) are sown in different hatches from February until the middle of July. The early sown will be in season to stand for seed ; or may be mowed for hay, if not wanted to feed off green.

Tares for hay, make a most excellent fallow year. They are mown before they draw or exhaust the land at all, and their extreme luxuriance and thick shade so mellow and loosen the soil, and kill all weeds, that if the crop be good, and the seed not sown later than February, there will be a very fair chance for a crop of turnips after them, on one earth ; but, without such luck, this husbandry is far preferable to sowing two crops of corn running. If a farmer thinks of sowing barley after wheat, barley, or oats, or oats after either, let him throw a crop of tares for hay between two of corn, and he will be sure to reap the benefit of it.

They will give him on middling land, from a ton and a half to two tons and a half of hay per acre, which, with their cleaning and meliorating nature, will be found far to exceed any second crop of corn on the same land.

The great objects of the tare-culture, are spring food for cattle, summer herbage, hay, substitution for clover, where that vegetable has tired the land, and as manure, to be buried by the plough.

In these various lights, the tare is absolutely invaluable, and since its merits have been known such a number of years, common sense is sadly at a fault, to account for its frequent neglect. The winter crop is obviously the most important, and perhaps with the view of obtaining spring feed very early, the first week in August is not too soon to sow tares; should they be drilled, or rowed in any method, (an uncommon but by for the best practice even when they are intended for feed,) the rows ought to be hoe-ploughed early in October, and the plants earthed up as high as possible, which always has an excellent effect in keeping them warm, and encouraging their thick and early growth. They may also be sowed equally mixed with rye, which nourishes, protects and draws up the tares; and it is not easy to contrive a crop which will pay so well, leaving the land at the same time, in so favourable a condition.—*Mr. Lawrence.*

There are numerous cultivated plants that are well known to possess merits in the soiling system, but as they are not so eligible in the economy of tillage, and as I have gone into a long detail on the more

general cultivated plants, I suffice myself by naming a few of them.

The culture of Lucern, has been strongly recommended in this country, but it has made very slow progress. Its principal merit, when planted on forward land, is its being ready to cut for soiling earlier in the spring than vetches or clover. It affects a good loamy soil, and from its abundant crop through the summer, exhausts the land it grows on, and requires dung or a compost dressing every year. It is generally sowed in drills, and in this case requires deep hoeing or forking at intervals, repeatedly through the summer.

The best crop of Lucern, and the one freest from weeds, that I have yet seen, was at Mr. John Pratt's, of Newfields, about seven miles from Kenilworth. It was sown broadcast, at the average of 16 lbs. of seed to the acre. Mr. Pratt said, he found a great advantage in thick sowing, and asserted that if he had any occasion for an additional plantation of the plant, he would sow 26 lbs. per acre. I saw this crop the last week in June, 1829; it had then been all cut once, and that part which had been cut first, had put up a second crop, which then weighed about 5 lbs. to the square yard, or nearly eleven tons per acre. I never saw any crop of any description freer from weeds. Indeed, the lucern was so thick on the ground, and from the nature of the plant so quick of growth, that it was impossible for any small weeds to thrive amongst it.

Mr. Pratt's method of cleaning the crop and pulverizing the soil, is worth the notice of agriculturists,

being so very simple and cheap, when compared with the row-culture. The implement he uses is what he terms the Shropshire twin-harrow, but its manner of working would be better understood by the reader if he were to see the harrow in action, than by any description that I can give him of it. The tines are shorter than harrow tines usually are, and are set curving or coulter-fashion, and from the elastic and tough nature of the root of the lucern, the tool works under the weed roots and completely heaves them to the surface, without injuring that plant. A pair of light harrows to follow, or work between the processes, to clear off the pelf, is all that is required, except the manuring. When this operation has been performed, at a proper time in the spring, I understand the field resembles a field recently sown with barley.

There appear to be other advantages attending this mode of culture, that the row-system does not possess. The compost may be worked into the land, and mixed more equally with the soil ; and if the crop decreases in plants, more seed may be applied and covered in with the harrow. With these advantages, the crop may be kept longer in the land ; but I should not omit to observe, that lucern, as well as sainfoin, take up gypsum from the soil, though in a smaller degree, as well as clover, and the land, in time, will require a dressing of that substance, independently of what it receives from the dung.

CHAP. XXI.

ON MANGEL-WURZEL—METHOD OF PREPARING THE
SEED BEFORE SOWING—ON CARROTS AND SWEDE
TURNIPS AS FOOD FOR HORSES—EFFECTS OF SALT
ON WEATHERED OR STAINED HAY.

MANGEL-WURZEL, (beet) forms a part of the soiling system, and is better calculated for neat cattle than other stock. This root is found to be very forcing both in flesh and milk; it gives a fine colour to the butter, and likewise improves its quality. The beet may be grown upon almost any kind of soil, if it be previously well manured; but beet, like cabbage, requires the whole of the summer to grow into a good crop. The stubble then should be free from couch, and ploughed early in the autumn, that the land may be well prepared for spring working. The seed may either be planted on ridges, or sown broadcast, but the first method, (as well as for fallow turnips,) is the more preferable way.

I feel a pleasure in communicating one particular circumstance relating to this seed, which, I believe, is not known to others, and I speak upon this fact from

my own experience. The seed, if it be planted as it comes from the stock, either lies dormant in the soil, or germinates very imperfectly, and in some dry seasons the crop has been lost; and steeping the seed for several days in water, previously to depositing it in the ground, has been tried with but little effect. The seed, it is well known, is covered with a husk, or is rather firmly enclosed in a kind of horny shell, which ought to be broken to admit the air to the seed before it is sown. This necessary operation may be performed by a very simple process, by laying the seed on a board, rough as it is left by the saw, and rolling it with a small hand roller, using sufficient pressure just to break the shell, without bruising or injuring the seed. When this operation has been carefully performed, the air will have free access to the seed, and it will then germinate, if not planted too deep, without meeting with any farther obstruction than is commonly met with by any other seed.

The above fact is scientifically exemplified by Sir H. Davy, in the following terms:—Seeds are incapable of germinating, except when oxygene is present. In pure carbonic acid, when moistened they swell, but do not vegetate; and if kept in these gases lose their vegetating powers, and undergo putrefaction. It is evident, that in all cases of tillage, the seeds should be sown so as to be fully exposed to the influence of the air; and one cause of the unproductiveness of cold clayey adhesive soils, is, that the seed is coated with matter impermeable to air.

Both horses and swine will feed heartily on beet, (mangel-wurzel,) and the leaves and fibrous roots are good food for the latter, but I have never found this plant to excel Swede turnips, for either horses or pigs. It has been recommended, by some who have written upon the subject, to cut the leaves at different periods through the summer and give them to either pigs or cattle. But this practice is not good policy when food is plentiful, as it checks the growth of the bulb. The proper method of preserving this root, is to gather it the first dry days in November, clean off the top and fibrous roots, and then storing the bulb in the bottom of a bay in the barn, or in some other out-building, with sufficient layers of straw to prevent it from fermenting.

This crop may be grown to as great a weight per acre as almost any other vegetable, and affords more of the saccharine and other nutritious properties than any of the plants in common cultivation: as may be seen by the table page—where a 1000 parts of the red beet, (mangel-wurzel) gives 148 parts of the nutritive properties, while the same weight of oil-cake gives but 151, only 3 lb. more, in a 1000 lbs., how improvident then, is it in the grazier to purchase oil-cake at £8 or £9. per ton, when he can raise beet at almost as many shillings?

Carrots have been strongly recommended as a field culture for horses and other cattle. The soluble or nutritive matter in carrots is 98 parts out of 1000; parsnips nearly the same; and Swede turnips 64 parts. The latter is equally as well calculated for horses as either of the former, and for cattle and sheep, better.

As these calculations are the result of experiments founded upon analization, it is scarcely necessary for me to say which crop would be of the greatest advantage both to the grower and to the consumer.—I believe, that neither Swede turnips, carrots, nor parsnips, at any season of the year, are sufficient food for a hard-working horse. I have proved, that horses in the stable, when they had become habituated to Swede turnips, will eat them in preference to corn, and that they are highly wholesome when given in moderate quantities; but a horse while working hard, ought not to have any the less corn for eating either Swede turnips, carrots, or parsnips.

Mr. Smith, the great posting-master, and stage coach proprietor, of Coleshill, gives his horses vetches in the summer, and Swede turnips in the winter. His horses are the most noted of any on the road for good health and good condition.

Mr. Packwood, of Coventry, another great coach proprietor, has long been in the habit of salting his weathered or stained hay, and finds that his horses eat it in preference to the best green hay, and to thrive equally as well upon it. When turned loose in the yard where both sorts of hay were lying, his horses have frequently been seen to leave the green in search of the weathered hay. While salt is so cheap, and as it is well known to be an ingredient both healthful and palatable to all kinds of stock, one is not a little astonished that, in bad hay-seasons, it is not brought into more general use.

CHAP. XXII.

ON LUCERN, CLOVER, VETCHES, SWEDE TURNIPS, AND MANGEL WURZEL, FOR SPRING AND SUMMER SOILING—ON POTATOES, HAY-TEA, AND DISTILLERS' WASH—THE STEAM-APPARATUS—NUTRITIVE PROPERTIES OF PLANTS AND THEIR VALUE PER ACRE—ON FEEDING SHEEP AND REARING LAMBS—ON BREEDING CATTLE AND SHEEP, AND ON THE CONSTITUTION OF ANIMALS.

IN the progress of this work, I have given many hints on the great advantages to be derived from soiling stock in the stable, yard, or buildings, instead of grazing them at large in the fields; and while I have endeavoured to shew the means and the end, I have also pointed out its practicability.

Lucern, Clover, and Vetches, form a prominent part of the crops best adapted for summer soiling; but there are other vegetables and food recommended for this purpose, which are not in general cultivation, such as Chicory, Burnet, &c. &c., which may be rejected. Indeed, it would be as well perhaps to dispense also with the use of Sainfoin, now Clovers may be depended upon. The Swede Turnip, and Mangel-Wurzel, are excellent plants, and they may with proper management and care, be preserved good until the

vetches are ready. Swede Turnips intended for soiling in the spring, should be taken from the land as soon as they are grown to their full size, the tops and roots cut off, and the bulb stacked in narrow piles with layers of straw; the more they are exposed to the air, and the more they are excluded from the sun, the better they keep, and in this way they may be preserved good and fit for use until the middle of June, if required. Lucern and Vetches are the first articles then for summer soiling, lattermath, clover, and cabbage next, and then comes the common Swede turnip; and with these six vegetable plants only, cattle and swine may be soiled all through the year; and sheep and horses any part, or even the whole of the year, at the option or convenience of the occupier.

Potatoes have been strongly recommended as food for cattle, and at one time they were brought into extensive use; and the cow-keepers near London and in other large towns, still continue to give them to their cattle. It has been said that potatoes possess some pernicious quality in a raw state; but it is well known that they are a good and wholesome food for all descriptions of animals when dressed. Pigs may be fatted cheaper with a mixture of potatoes and meal than with any other food. The food for pigs, of whatever kind it may be, should be given to them in a warm state, particularly in the winter, and many do not hesitate to contend that most other roots and vegetable substances, such as corn, meal, linseed, oilcake, &c. &c., are more nutritious for most kinds of stock

when steamed, than in a raw state.—Poultry of every class may be fattened with potatoes alone.

Hay-tea, (a decoction of hay,) has long been found to be a fine liquid for rearing calves; and in forcing milk, or fattening cows or oxen. I have no hesitation in saying it ought to be given to them as their drink. Distillers' wash, it has been proved, will force either flesh or milk; but hay-tea is more healthful and more nourishing. As these articles require a proper apparatus to manufacture them, the small farmer perhaps might think too much of the expense; to this I shall observe that the size of the apparatus, and consequently the expense, would be more or less according to the size of the farm on which it is to be employed.

The greater number of those artisans who formerly boiled their articles of manufacture, now employ steam, which they find to be a more economical and a better way of preparing them for their various purposes of trade. One steam apparatus now does the work which formerly employed several boilers; and by small pipes projecting from the main in different directions, the steam is conveyed to a considerable distance.—That the steam apparatus has not been brought into use in large agricultural establishments, and in all public institutions to which they are suited, has excited some surprise in the minds of those who have witnessed its powers, and have reflected seriously upon the various purposes to which it may be advantageously applied. One apparatus may be so fixed, as to perform the domestic concerns in the house, while at a conve-

nient distance from the dwelling, it is preparing food for the cattle. It will heat the water for washing, brewing, cleaning the dairy vessels, and all other household purposes ; boil the joints of meat, and cook the roots and vegetables at the same time.

They who have seen this piece of machinery at work at the manufactory, would be convinced of its practical usefulness on large farming concerns ; to describe the apparatus to them would be needless, but to those who have never seen such an engine in full operation, a brief description of it may not be devoid of interest ; and as my object here solely is to convey the idea of its practicability on an extensive farm, to the Agriculturist, I hope the following explanation will be clear and intelligible. The construction and the manner of working the Steam Apparatus are both very simple. The boiler is of an oval form something like two iron-boilers if laid mouth to mouth, and rivetted together ; the size depends upon the power which it is intended to supply, say 100 to 120 gallons for a large concern ; 20 or 30 gallons would be sufficient for domestic purposes alone. The superfluous steam, that is, the excess of power, escapes through the safety-valve ; the great use of this valve is to prevent the boiler from being over-charged by regulating the pressure. The steam is turned on and off by a stop-cock fixed on the main or principal pipe ; the boiler is supplied with fresh water by a pipe through the top, and as it conveys the water to the bottom of the boiler, no steam escapes. Other pipes affixed to the main convey the

steam to separate tubes, which are of different sizes suited to the purposes to which they are appropriated. For making hay-tea for cattle, say it would require a tub from 200 to 500 gallons, or according to the number of cattle intended to be supplied with the liquid ; and a smaller tub for potatoes or other vegetables, the size of which would be regulated by the number of pigs or other cattle it was intended to supply. The steam intended for domestic purposes is conveyed by a pipe under ground to any convenient part of the dwelling-house, and then by other small pipes to the different tubs or other vessels where it may be wanted. The tube of the pipe, which regulates the quantity of steam, should be proportioned to the size of the tub, the extreme end being of the syphon-form to send the steam to the bottom of the fluid in the tub. Each pipe has a stop cock to turn the steam on or off. When all these works are connected together, the speculation would appear too large for a plodding farmer ; but where potatoes are grown for the purpose of cattle-feeding to any great extent, they ought always to be dressed, and no other mode of cooking them is so economical as steaming ; and where they are used in large quantities as food for cattle, as they are by the cow-keepers near large towns, one would suppose that such a mode of preparing them could not be dispensed with, and that the cost of a steam-apparatus would be saved in one season.

The steam-apparatus would be a great acquisition in those public institutions, where large quantities of

pea and other soups are made, or great quantities of roots and vegetables are dressed ; and wood, every one knows, is not only more wholesome, but more easily cleaned than metallic vessels ; and the joints, potatoes, and other vegetables are all cooked in separate tubs, from one small furnace.—Potatoes, when steamed, are more nutritious than any other vegetable or root, excepting meal, which may be seen by referring to the table page ; and their nutritive properties, compared with oil-cake, are as 4 to 3. It is not practicable to boil linseed or meal in metallic vessels, in large quantities, but that can be done safely in wood by steam ; and I am of opinion that where there is this convenience it would be more economical to steam corn for pigs than to grind it into meal. Pigs feed better and thrive faster on any food when it becomes acid, than when it is sweeter, or fresh mixed.

Sainfoin and Clover, contain 39 parts in a 1000 of soluble or nutritive matter ; Lucern, 23 parts in a 1000, so that by estimating their comparative value by the soluble or nutritive produce, and when green Clover is worth 7*s.* 6*d.* per ton, Lucern is only worth 4*s.* 5*d.* per ton ; but this does not under-value the crop by the acre, for I should estimate the entire produce of an acre of Lucern at full one-third more than a crop of Clover, and one-half more than a crop of Sainfoin. In the table, page 221, it may be seen that common turnips, contain 42 parts in a 1000 of soluble or nutritive matter, and by estimating their value at 5*s.* per ton, and comparing them with other vegetables, and

vegetable substances, and according to their soluble or nutritious properties, their value per ton will be found as under ;—

<i>Soluble parts in 1000.</i>		<i>Value per ton.</i>		
		£.	s.	d.
42	Common turnips	0	5	0
64	Swede ditto	0	7	7½
73	Cabbage	0	8	8¼
98	Carrots	0	11	8
99	Parsnips	0	11	9¼
151	Oilcake	0	17	11½
148	Beet, (mangel-wurzel)....	0	17	7½
250	Potatoes	1	9	9½

Value per acre, taking a comparative proportion of weight the respective plants produce, from the different soils on which they are in general planted :—

<i>Tons.</i>		£.	s.	d.
20	Common turnip, best dry loam 5s. per ton	5	0	0
20	Battase and drum top cabbage, average weight on all kinds of soils, 8s. 8½d. per ton	8	13	9
20	Swede turnips on heavy and light loams, 7s. 7½d. per ton	7	12	1
10	Carrots on a deep sandy loam, 11s. 8d. per ton	5	16	8
10	Parsnips affect the same soil as above 11s. 9½d. per ton.....	5	17	6
15	Beet, (mangel-wurzel,) both heavy and light loams, 17s. 7½d. per ton	13	4	0½
12	Potatoes, dry light loams, £1. 9s. 9d. per ton	17	17	0
30	Lucern, dry keep and good light loam, 4s. 5d. per ton.....	6	12	6

Soluble or Nutritive Matter per Acre.

Vegetables or Vegetable Substances. TONS PER ACRE.	Whole quantity of soluble or nutritive matter.	Mucilage or Starch.	Saccharine, matter or Sugar.	Gluten or Albumen.	Extract or matter rendered insoluble during evapora- tion.
	<i>C. qr. lb.</i>	<i>C. qr. lb.</i>	<i>C. qr. lb.</i>	<i>C. qr. lb.</i>	<i>C. qr. lb.</i>
20 Common Turnip.	16 3 5	2 3 5	13 2 11	0 1 16	
20 Swedes	25 2 9	3 2 11	20 1 16	0 3 5	0 3 5
20 Cattle Cabbage	29 0 3	16 1 26	9 1 11	3 0 22	
15 Red Beet, (Mangel Wurzel).	44 1 15	4 0 22	36 1 5	3 3 16	
12 Potatoes	48 0 0	37 0 23	3 2 11	7 0 22	
10 Parsnips	19 3 5	1 3 5	18 0 0		
10 Carrots	19 8 11	0 2 11	19 2 11		
20 Ton Linseed Cake ..	60 1 25	49 0 22	4 1 16	6 3 15	

Meal and oilcake seem to bear no competition with roots and green vegetables, in point of economy, in fattening herbaceous animals, and perhaps ought not to be had recourse to only in times of necessity, or when good hay is not plentiful; and in those cases it should be used only for a few weeks in finishing the animal. The unthrifty animal will never pay for corn, and good thrivers may be made fat enough with good hay and roots.

I know it is the practice in some parts of the country to give corn to sheep while they are upon turnips. Sheep may be made fat in any country with plenty of turnips and good lodging. If a field lie bleak and the lodging is bad, there ought to be a temporary burrow erected, with a littered yard for them when they choose to retire to it. My practice in feeding ram-lambs, was to give them cabbage for a month at Michaelmas, and to confine them afterwards to a small space in the turnip-field, where I built a temporary hovel, and

enclosed a yard which I littered well for the sheep to run into occasionally. I gave them no other food than Swede turnips chopped, and a rack of barley straw for them to browse on. At the beginning of May, or when the seeds were ready to stock, the sheep and the troughs were removed to them, and they were supplied with what turnips they would eat till June, when they were sheared. The culls having been drafted for slaughter, I then sold them by weight, and they have often, in different years, weighed from 25lbs. to 27lbs. per quarter; while the ewe and cut lambs of the same breed, fed on common turnips, and hurdled out in the usual way, only weighed about 16lbs. to 17lbs. per quarter. Here is another proof of what may be effected by soiling.

I have tried most other roots and vegetables with and without hay, (I never used corn,) and I never found my sheep to thrive so fast on any other food as on Swede turnips, with a little fresh-threshed barley straw to pick at, as their nature and inclinations led them. When I gave them good green hay instead of straw, they then ate more hay and less turnips, and the consequence was, they did not thrive so fast. The little straw they ate, probably, was sufficient to assist the digestive organs better than a greater quantity of dry food; however that might be, the larger the proportion of turnips which the sheep consumed in a given time, the quicker they became fat. The Leicester breed of sheep at that time, (about 1790,) had made but little progress in this country. A number

of farmers have since adopted a similar mode of treatment of their cut lambs, and have sold them when about fifteen months old, and they have then weighed from 24 lbs. to 26 lbs. per quarter, and in some instances a higher weight. But it cannot be expected that any breed of animals can be brought to this high state of perfection without good nursing; their food must be given to them in regular and small quantities, three or four times a day; their troughs must be kept clean, and their lodging dry, and sufficiently warm.

With such management, I believe that neat cattle may be fattened with the more nutritious roots and hay only, in as quick a time as they can be with oil-cake and corn, and at a much less expense. But there is another thing in the economy of breeding and feeding, which is of much greater importance than the kind of food that is given to the animal—and that is ITS APTITUDE TO FATTEN. It is a fact well known, that the stock of some particular breeds will fatten on the same kind of food, in half the time that some other breeds will do. The old vague assertion, so prevalent formerly with men of strong prejudices—that half the breed goes in at the mouth—is rarely if ever heard of now.

We must admit, that cattle of almost every description, from various parts of the country, do bring more meat to market, on less bone, and by the time they are got to half the age, than they formerly did. But there still exists some prejudice, amongst the more

unenlightened breeders and feeders, as to what constitutes a good animal ; and we still find some people to hold the opinion, that no sheep, cow, or ox, can be a good one unless it be a great one. Nature has formed animals of different classes, to suit every variety of soil and situation ; and it would be no less absurd in any one to expect a barn-door fowl to grow as large as a turkey, or a partridge to attain the size of a yard fowl, than that all cattle or sheep, whatever may be the care used in their breeding and rearing, should come to any thing like the same weight. In cattle, the Herefords, the North Devons, and Scotch runts ; and in sheep, the Leicesters, the South Downs, and the Exmoors, may sometime or other all become mixed as to be indistinguishable, but while they continue to breed from none in each district but the pure stock, their different characteristics will remain, both in colour and size, and consequently in weight. The same observations will apply with equal truth, to animals of every other class.

Neat stock, calculated for a rich, deep, well sheltered country, are badly adapted to heathy and mountainous districts ; and the mountain cattle, probably, would make but small profits if wholly reared on the good land ; and on this subject perhaps most people will agree. But the mountain or heath stock, whether sheep or cattle, vary much in value, and it is a very rare thing to find amongst them, what all breeders and feeders wish to obtain, namely, an animal large in size, with a disposition to fatten quickly, and supe-

rior in quality. It is not often that we find the biggest animal to be the best, in this breed of stock, even when they have been fattened on good land. And if we are to take the laws of nature as our guide in the cultivation of this stock, it must be evident that in attempting to make any improvement in it, quality and not size must be the object we should endeavour to attain. When this end is acquired, and we have obtained the quality, nature settles and accommodates the size of the animal according to soil and situation. Nature herself never errs, and all the apparent contrarieties that are to be found amongst the whole of her numberless and marvellous productions, always arise from adventive causes. The whole art of breeding, either of a flock of sheep or a herd of cattle, consists in selecting the most perfect models in shape and symmetry, with the most likely aptitudes, as far as the judgment can determine, to fatten.

My belief is, that both the breeder and the grazier are often disappointed in their expectations by being over covetous of size. If any of the different breeds of cattle, sheep, or hogs, are to be improved, and the value of the produce increased by crossing, the breeder should proceed upon fixed principles. His attention should be directed to the following objects:—

1st—To the constitution of the animals.

2ndly—To their aptitude to fatten at a young age.

3rdly—To symmetry in the shape, as it indicates level fattening; with a comparative smallness of bone, as indicative of quick feeding.

4thly—To a broad flat back and circular chest, as they give a larger surface, and produce a due proportion of fat and lean.

But neither one nor the other of these qualities will be sufficient to constitute a good race of animals, and it is necessary to combine the whole in the same beast, to have a perfect and complete breed.

If we inquire how the great improvements now existing in the different races of our stock animals have been effected, we shall find that constitution has been the great engine by which those improvements have been made.

If we look back and inquire how our best breed of race horses was obtained, we shall find that the blood originated in the Arabian, a dwarf in size, but an animal gigantic in *constitution*.

CHAP. XXIII.

OBSERVATIONS ON THE COMPARATIVE SYSTEMS—
ADVANTAGES OF SHEEP GRAZING, COMBINED
WITH THE IMPROVED SYSTEM—ON SOILING SHEEP
ON CLOVER AND OTHER CROPS—COURSE OF
CROPPING—CLOSE CROPPING NOT INJURIOUS TO
LAND—EXTRAORDINARY TURNIP-CROP AT MAR-
TON—ON MILDEW IN TURNIPS AND WHEAT.

THERE are but very few practical men that are not partial to what is called the *Sheep-husbandry*; and most writers on agriculture seem to encourage the keeping of sheep, not only as a profitable branch of the art, but as the best and most economical method of improving the land. The common phrase upon this subject is, the more sheep the more corn; or, in other words, clover is a nursery for sheep, and sheep promote the growth of clover. The reader must have observed that one of my principal objects, in the course of this work, has been to shew in which way the most sheep-food can be raised on a farm, when combined with other profitable branches of husbandry. I presume I have proved, in the last comparative systems, (pages 252-3,) that on the very best kind of land, as

much in weight of fattening food may be raised by artificial crops, between the corn crops, as the same kind of land produces in natural grasses, besides the abundance of other food raised for store cattle. Now if any farmer of experience will look at the different tillings which the land must undergo in order to raise those green crops, he will not, I am certain, hesitate for a moment to admit that the land, with all that tillage must naturally be kept clean from pelf; and if he will compare dispassionately in his own mind, the quantity of manure raised and required on both grass and arable land, he will find the balance, as it respects the improvement of the farm, to be in favour of the latter. I am willing at the same time to admit, that the best grass land, when in good condition and well grazed, will keep up its fertility; while poor grass land, even when properly stocked and well grazed, will often retrograde.

Almost any kind of grass land, if dry, may be improved by ploughing, and no more dung is requisite than what may be made from its own produce, by a judicious introduction of green crops. Then if this system be once admitted, the question may naturally be asked, what is to be done with the manure made in populous towns? My answer to such an inquiry would be, as the arable land, under this mode of cropping, would be sufficiently enriched without it, let it be applied to the meadow land and gardens.

I wish it distinctly to be understood, that I do not contend that arable farms do not require any other

kind than what animal and vegetable manure can be raised upon them. Lime, or calcarious earths, (as I have previously observed,) are absolutely necessary to advance fertility on all land; they act both chemically and mechanically on various soils. Clay or marl improves the texture of sandy land. Sand meliorates clayey land. Lime, torrifed earth and coal ashes, have the tendency to break the tenacity or glutinous properties of clays, and cause them to absorb and admit the penetration of moisture, and give to soils the power of holding it longer, and to emit it more freely to plants. Lime, by its mechanical properties on sandy soils, acts as a cement in connecting the fine particles, so as to prevent rains from filtering through them so rapidly and in consequence of holding the moisture longer, the scorching rays of the sun, or the drying winds, less affect the growth of plants.

The great object of those agriculturists who have the improvement of their farms in view, is to keep the greatest number of sheep on a given quantity of land; and it may be doubted by a superficial observer, whether as many can be kept on the improved system, as there could be by the old and customary methods. By referring to the 80 acres in Class 1, page 83, and to the 50 acres Class 2, page 87, we shall find that 130 acres summer 190 sheep, and with the addition of the turnips and winter and stubble herbage, they will winter 140. By the improved method, there are 62 acres 2 roods, annually, of vegetable food for sheep, or to be applied to other purposes, viz. 26 acres 1 rood of

vetches, 16 acres 1 rood of clover, 6 acres 1 rood of Swede or fallow turnips, and 18 acres 3 roods of turnips; or a part of the land may be sown with rye to be eaten off in the spring. The vetches will be ready to stock on the first of June, and if the seed be drilled in at different periods, so that the crop may be taken successively, a part of it will remain green and good for two months, and by the first of August, the 190 sheep will have consumed about fifteen acres of the vetches. The lattermath clover will then be ready to receive them; and that will be able to keep them until they may be turned upon the first sown turnips, after vetches; and the 6 acres and 1 rood of Swedes, and the 18 acres and 3 roods of rye and rape mixed, in any common season, and an average crop, will be more than sufficient to keep the 190 sheep until May-day, if required. In about a month from that time the vetches will be ready to carry them, and they will then require a part of the clover to support them for that period, and it may afterwards be mown for fodder, or soiled off green for other stock.

I have now, I trust, satisfactorily shewn that the improved system will not only keep a greater number of sheep than can be supported on the same quantity of land cultivated in the customary way, but would summer a much greater number; for in the first place, the entire first math of the 16 acres 1 rood of clover, might be reserved until the 1st of August; and so might the 11 acres 1 rood of vetches, if a part of the stubble were sown with rye instead of brush turnips;

or what would be better, to drill a part with a mixture of rye and rape, or with both, which would be ready for the sheep by the time they had consumed the turnips. But if vetches are to be eaten off twice, they should always be drilled, and rather more seed should be put into the ground than when they are only to be stocked once. I have known instances of vetches that had been eaten off in May, produce a second crop by the latter end of June. Yet they are not so well calculated for regular grazing as rye; for if they are sown by hand, the sheep are apt to bite them so near to the ground that they are often prevented from throwing up a strong shoot, and for that reason the drill is preferred. Besides the plants seem to grow faster in drills or clamps, than when they stand singly.

Clover is given to sheep in various ways. Sometimes it is mown and carried off the land where it grew, and they are soiled with it in another place; at other times the crop is mowed and given the sheep in breaks and the hurdles moved on as in vetches; either of these ways is preferable to that of letting them range unnecessarily, over a larger breadth of ground; as what they trample down with their feet, and injure by biting and haggling the stems, does considerable mischief in rank crops. The great advantages of manuring land when free from twitch-grass, then sowing it with vetches, and eating them green with sheep, have been often proved in my own practice; yet some of those farmers, who have never tried the experiment, may perhaps imagine, that I have been too sanguine

in speaking so highly of that system of culture. To such I would observe, that small benefits, collected from different sources, when brought into action upon any particular point, and so blendid as to support and strengthen each other, will produce great effects. Let the farmer first consider the great advantages that will be derived from getting the vetch crop so soon off the land, on light soils; and the opportunity that it gives him of making the best use of the summer months to cleanse and pulverize the heavy soils, and into what good condition he may get his land for the succeeding crops of barley and clover, and he will no longer be disposed to resist the practice I have here so strenuously recommended. Nor is this all, he should likewise take into his consideration, the difference of the labour he would be called upon to perform in the busy months of spring, in following the system that I have laid down; nor should the fact go unnoticed, that scarrifying fallow land in the spring as soon as it is dry, has often many advantages over the plough, as it mellows the surface soil, and leaves it finer and in a better condition to receive the seed. It encourages the annual seed weeds to vegetate, and they are destroyed by the second process; and without saying anything of the clover crop, the barley may be estimated to yield at least four bushels per acre more, on any kind of land, than after cabbages and turnips; and I may further add, that few crops are grown at less trouble and expense than vetches. They improve the future crop so much by the quantity of soluble

matter which they afford to the land, they are such excellent food for herbaceous animals of every kind, that I have no hesitation in recommending them strongly in the economy of tillage.

Cabbage, as they are calculated for the clays and heavy loams, and will also grow on peat and light soils, have their value ; but on all poor soils, they, like vetches, require to be plentifully manured. Though they affect a deep soil, they may be grown to a great weight on the poor thin soils, by ploughing the land into three foot ridges ; and it is absolutely necessary to cultivate cabbages in this way on all soils, as they require to be planted early, that they may have the whole of the succeeding summer to bring them to perfection : here the Tull husbandry can be used with advantage, and the land may be kept clean, comparatively speaking, at a small expense. The culture of cabbage, although it do not combine so many good qualities as turnips and vetches, ought to form a part in the economy of farming, on the clays and heavy loams ; a pleck of cabbage, even on a turnip farm, has some excellencies to recommend it to the notice of the agriculturist, as they are often ready to stock sooner than turnips. Young sheep, intended to be wintered on turnips, (and more particularly lambs,) should always be fed for a while on cabbage, as they entice them to take more kindly to the turnips. They are also useful in the many changes of the weather in winter, when the frost and snow prevent the farmer from getting at his turnip crop, as the cabbages can be come

at in all weathers, and sheep will eat them greedily, when the turnips, from being frozen so hard, are rejected. The turnip crops often sustain a great loss in frost and snow ; for if snow should fall, and a turnip is bruised or broken by the feet of the sheep, or has been bitten by one of them, when the frost breaks, all those turnips perish ; but these losses are avoided when there is a pleck of cabbage to go to in the precarious months.

In calculating the difference of profits between the two systems, in page 141, it will be seen that there is an extra expenditure of £16. 13s. 5½*d.* for manure on the improving system. This expense, I should observe, is requisite only where the land, through improper cropping, has been reduced beneath the standard of its natural fertility ; and as it may, probably, after the first course of eight years, be dispensed with, the difference of profit in favour of the improved system, (on the 80 acres,) will be £90. 15s. 1½*d.* instead of £74. 1s. 6*d.* There is also some variance in the produce of the clover crop, but every one knows that clover crops are now become more precarious on a quick repetition than they formerly were, and that a greater produce is expected on a longer than on a shorter course of cropping. If clovers were to be sown no oftener than every eight years, (as I have before observed,) a full crop might be expected, but if they be planted on the same land every fourth year, we sometimes have not more than half a crop.

To explain the mysterious cause of this failure, has not, until lately, been attempted ; but I trust the

foregoing observations and experiments will tend to remove the veil by which it has so long been obscured ; and if, by the application of gypsum to the soil, a full crop of red or broad-leaved clover can be obtained, when sown every fourth year, there is no course of cropping that can be more eligible, either on the light soils or on the heavy land. The course will then be on the former as follows :—Wheat, Turnips, Barley, Clover, substituting on the clays or heavy loams, Cabbage, Rape, or Vetches, for Turnips. If manure be applied for the green crops, and the course is followed up afterwards with proper tillage, no other fallow will be necessary. Neither does such a system require so much tilling after the first four year's course ; for neither couch-grass, wire-worm, nor seed-weeds of any description, can accumulate under this system of husbandry.

Yet, the four-year course will neither afford so much food for sheep, nor yield so much profit to the cultivator, as the eight-round course. If we compare this system with Class 2, page 107, we shall perceive the difference in profit to be nearly eight shillings per acre, and the weight of food for sheep one-third more ; but it will be seen that the drawback for the purchase of manure, is something greater on the four, than on the eight-round course ; but the extra quantity of manure is not equal to the improvement which the land receives from the increased quantity of vegetables raised and consumed on the longer course. The long course on all kinds of land returns the most

profit to the occupier than the shorter ones ; no land, when out of condition, can return that compensation to the occupier which he ought to receive, and when once cleaned and put into good heart, the eight round course is the system best adapted to keep it so. In order to grow the greatest quantity of food on a farm for the support of herbaceous animals, the cultivator must store it plentifully with such materials as are best suited to feed those plants which he intends to raise ; and to do so, when one crop is taken off the land, as little time as possible should be lost before it is planted with another. All land, indeed, when it is not in grain, should be employed in raising food for the stock on the farm.

Impressed with the idea that a close repetition of crops tires the land, some persons have an objection to grow stubble turnips, being of opinion, probably, that they have the same effect upon the soil as red clover. But turnips do not require any manure than what is common to other plants ; nor do I know of one instance, upon any sort of land, which has been well manured, where they have ceased to grow, in consequence of that crop having been too often repeated. Nor can I find any reason, founded upon chemical and philosophical principles, against a close repetition of that crop ; yet they no doubt, like other plants, not only affect particular manures, as well as a particular mixture of the earths. The best turnip soils, generally speaking, consist of about three parts of sand, or silica, and one part of alumina, or clay ; or those

mixtures that retain moisture and give it out in due proportions.

Water is the great agent in preparing food for plants ; the earth the repository for fixing and holding their roots ; and their food is the remains of decayed animal and vegetable substances ; and their perfection and maturity depend on the preparation and administration of their food. Plants become sickly either with too much or too little moisture. The former may, in some measure, be guarded against, in the turnip crop, by planting the seed on ridges, which prevents the soil from holding too much water, and in consequence, the carbon, or manure, is supplied to the plant in a much purer state. This fact has been illustrated in one instance this year, (1830,) on the farm of Mr. Russell, of Marton, who has grown Swede turnips on ridges, of the extraordinary weight of 23 lbs. each, and the bulk of the crop weighed from 12 lbs. to 20 lbs. each ; and in a season too, when almost all the turnip crops have been stunted in their growth by the constant and heavy falls of rain. But I should not omit to state, that the ridges had been dunged and set up for mangel-wurzel, and that crop having failed, the seed of the turnips was deposited on them on the 4th of May, so that they had the whole summer to thrive in.

Many others as well as myself, have no doubt observed, that the growth of early sown turnips is often impeded by mildew, and more particularly so if the season prove dry in August and September : and the cause of this obstruction to the crop appears to arise

from a want of that moisture in the soil which is necessary to prepare and administer nourishment to the plants. The mildew in the wheat crop originates in a cause directly the reverse of this ; for it is well known that wheat is most affected with mildew in a wet season, and that the straw is brighter, and the corn larger and finer in a hot and dry summer. The cause of mildew in wheat, it is generally supposed, is generated in the humid temperament of the atmosphere ; but is it not probable, from the food in the soil becoming diluted and impoverished by an excess of moisture, that this disease may be taken in by the root ? We all must unhesitatingly admit that wheat is more shrivelled and lean in a wet season than in a dry one ; and on this principle being conceded, would it not be worth while to determine the doubt by setting two-bout ridges for wheat ? If the ridges, by shutting off the rains, become drier than the other parts of the land, the mildew is prevented, and the grain in a wet season grows heavier in the corn and finer in the skin—then the question, after being confirmed by other and more extensive experiments, would be solved, and the discovery would be one of no small importance.

The smut in wheat, formerly, was supposed to be the effect of atmospherical influence ; but I proved more than fifty years ago, that the disease originated in the root.

CHAP. XXIV.

ON SHEEP HUSBANDRY.

SHEEP, in all civilized countries, have formed a favorite and interesting part of husbandry from the very earliest ages. Abel was a keeper of sheep; Abraham and Lot separated after their return out of Egypt, for their substance was so great in flocks and herds that the land was not able to bear them that they might dwell together; Rachael was a shepherdess; Jacob became a great flock-master; and David kept his father's sheep; and the business of a shepherd, at the period of the Christian era, was esteemed to be a life of innocency and contemplation.

The Fold, in this country, has always been considered to be a leading branch of Agriculture. The ancients depended upon it for the support of their corn crops; and from that circumstance, probably, arose the adage, "the more sheep, the more corn," which is even applicable to the state of agriculture as it is practised at the present day; and although we find that the customary mode of folding has been on the decline for the last century or two, yet there can be no doubt that the stock of sheep in this country has been increasing during that period; and the great comforts, and I may add blessings, which this country

derives from the Flock, are too obvious to require from me any farther comment upon the subject.

The object of this Chapter is to discuss, and determine, as far as my limited abilities will admit, the following momentous question, namely—To what extent the Fold may be increased, without diminishing the quantity of Corn?

In treating of this subject, I shall consider, in the first place, what quantity of food it is necessary to provide; and secondly, how that food should be distributed to the flock regularly throughout the year. And perhaps, I cannot do this in any other way so well as by exhibiting a short Calendar of the seasons of seeding, and the times when each species of vegetable should be consumed. I shall adopt this scale to three descriptions of land, as follows: viz. 80 acres of good turnip and barley soil—80 acres of good wheat and bean soil—and 80 acres of oat and wheat soil. The rotations as under:—

TURNIP SOIL.

ACRES.		TONS.
10 of Wheat on Clover Ley, 5 tons of Stubble	}	250
Turnips or Rye & acre.....		
10 of Swede Turnips, 20 ditto.....	}	220
10 of Barley		
10 of Winter Vetches, 12 tons, Common	}	220
Turnip, 10 ditto ditto		
10 of Barley		
10 of Winter Vetches and Turnips		220
10 of Barley		
10 of Broad-leaf Clover, 20 tons ditto		200
		<hr/> 890

BEAN SOIL.

ACRES.		TONS.
10	of Wheat on Clover Ley	
10	Five tons of Rape on the Stubble, and 20 } ditto of Cabbage after the Rape	250
10	of Barley	
10	of Rape and Cabbage, as above.....	250
10	of Barley	
10	of Rape and Cabbage, as above	250
10	of Barley	
10	of Clover, 20 tons $\frac{1}{4}$ acre	200
		<hr/> 950

OAT SOIL.

10	of Wheat on Clover Ley, 6 tons of Rape } or Rye	160
10	of Vetches after	
10	of Wheat or Oats.....	
10	of Rape or Rye, and Vetches as above	160
10	of Wheat or Oats.....	
10	of Rape or Rye, and Vetches as above	160
10	of Oats	
10	of Red or Broad-leaf Clover, 15 tons	150
		<hr/> 630

The total annual produce of vegetables from the 120 acres is 2470 tons. This quantity, if soiled off, and supposing that each sheep consumes, or requires 20 lbs. of food per day, will supply 757 sheep, or 378 sheep and 48 oxen or heifers, with sufficient food the year round.

The spring months have always been considered as the most difficult season to supply stock with vegetables, or vegetable roots.

Swede turnips and mangel-wurzel have been re-

cently introduced into this country ; and although the importance of these crops is well known, I do not think that the proper season for consuming them has been investigated with that attention which a subject of so much importance deserves.

I have had a good deal of experience in the growth and application of Swedes, and have also acquired some knowledge of the properties of the wurzel ; and that practice I have carefully compared with the observations of others. An objection has been taken to this root by some farmers, who say that they do not grow crops of barley so good after Swedes as they do after the common turnip ; others complain that they are so hard that they injure the mouths of the sheep. If I concede to these objections every thing even to which they can have any reasonable claim, that would not militate against the many advantages that are to be derived from this crop ; as I contend, that by proper means, these objections may be removed. Swedes, I admit, generally remain longest in the ground, and draw considerably from it when they begin to run in the top ; but if they be taken from the land upon which they grow, in November, or whenever they have attained their full size, then of course the exhaustion ceases, and the cultivator has a better opportunity of preparing the land for the next crop. The second objection is evidently removed by the means which I have recommended to obviate the first. When the turnips are taken from the land, what nourishment they afterwards receive, they draw from the atmos-

phere, by which they are mellowed, and become more nutritious, and they will continue good even to the latter end of May or the beginning of June. Then, when all the expenses of drawing this crop and carting it from the land are included, they appear as trifles when compared with the advantages that will be derived from it. When heavy tender land is trampled in wet weather, the succeeding crop is undoubtedly injured; while, on the contrary, when the vegetables are eaten on dry sound land, the treading of the sheep has a beneficial effect upon the soil. Swedes and wurzel may be grown on almost any kind of soil, as well as cabbage, but when they are grown on wet ground, they should be removed to dry land at a proper season, to be consumed.

The 2470 tons of vegetables, should be divided for consumption, as follows:—

250 Tons of Common Turnips, from 22d January, to March 1st.

530 Ditto of Swedes and Rye, from the above date, to the 20th May.

390 Ditto of Winter Vetches and one mowing of Clover, to the 14th July.

700 Ditto of Summer-grown Vetches and Clover, to the 25th October.

600 Ditto of Cabbage, to the 21st of January.

By pressing so earnestly as I have done, improvements upon my friends, I am well aware that I shall be censured by some of my brother agriculturists of the old school, and who may, in their rigid attachment to ancient customs, say that what I have recommended, is visionary, speculative, and impracticable; and this

has ever been the case when any new system has been introduced to their notice. I have known a much greater weight of either kind of vegetables grown on similar soils, than what I have just stated, and I have not, I am certain, calculated their weight too high, on the average of seasons. Twenty tons of clover per acre, taking the average of crops, would to some appear almost incredible, but as such facts have occurred within my own knowledge, I do not hesitate to repeat that the weight may be grown on the best soils, weighing the first, second and third crops, when in the highest state of mucilage.

Before drills, and other newly-invented implements were brought into general use, though they were approved of and recommended by those who had tried them, they were much condemned by the farmers of the old school; and therefore whatever opposition I may experience from the same class, will not in the least excite my surprise, although it may create in my mind just cause of regret. Yet, when those very persons had tried the machines above alluded to, and their prejudices had been removed by actual experiments, they became the most zealous advocates of their utility.

Most of our practical farmers, at the present time, admit that agriculture is yet in its infancy, and that there is still room for great improvements. Most writers on this subject are of the same opinion, but none of them, that I am aware of, have gone the same length that I have done, in unfolding and exposing the absurd

practice that now prevails to an almost ruinous extent, in most parts of the country, and in boldly pointing out those improvements by which the defects of the present system may be gradually and effectually remedied. I have much to regret, however, that this undertaking has not fallen into hands more capable of appreciating its importance, and of vindicating its practical utility. Still, if any thing that I have suggested, shall be of the smallest use in leading to improvement, I shall feel highly recompensed in having contributed my humble mite to the benefit of the present generation and of posterity.

Numerous Calendars have been written for the instruction both of gardeners and young farmers, pointing out to them the proper seasons for seeding the land and performing the other necessary labours in the garden and in the field; and as what I have latterly pointed out to the notice of the farmer, is somewhat novel to most of them, I shall endeavour to explain my system also in a similar manner.

The spring months, as before observed, is the most difficult time to supply sheep and cattle with green vegetable food, therefore I shall begin with March. It will be seen by the last tables, that 60 acres out of the 240, may be annually employed in the growth of vegetables, for spring grazing with sheep. Rape, vetches, and rye, are all hardy plants, and may be grown and eaten on the heavy land in the spring and summer months, but if the season be wet and the land too tender, the sheep may be moved off and fed in

the yard or a dry field, on Swedes, and the rye and rape eaten at intervals, when the land is in the best state to carry them. If the land be dry, then the Swedes may be cut and given to them in troughs in the rye-field, or barrowed about and chopped small; but the former is much the better way.

The rye and rape should be finished off the heavy soils early in May, and the land prepared for cabbage. The clods should be well reduced and the ridges set at about 27 inches from each other. This is an eligible distance for removing the crop off the land, the horses and wheels of the cart going in the spaces between the ridges, little or no injury is effected in the succeeding crop. It will require about 7740 plants to the acre, and if the cabbage average 10 pounds when at full growth, there will be upwards of 34 tons per acre.

The rye on the oat land may be grazed until the 20th of May, when the ground should be ploughed and worked in the same manner as for the cabbage crop, and the dung then carted on; unless the ground had been dunged for rye, which would have been the better way. The vetches should be drilled in rows at about eight inches apart, and about two and a half to three bushels per acre.

About this time, (May 20th,) the winter-vetch, or clover, is becoming ready for soiling, when a sufficient breadth should be mowed and carried off, to make room for the first Fold. These two crops (not like the rye,) must be soiled and eaten in racks in the fold,

which is moved on daily as the land is cleared. If rye be drilled in with the vetches, for the consumption of the first ten days, the crop will be earlier, and produce more keep. The land having been manured for the last crop, will require nothing more than to be worked in the way above directed. The turnips to be drilled in rows (unless ridged,) eight or ten inches apart, at intervals, as the ground is cleared and made ready. If the season has been wet, and any slug is in the ground, a few quarters of quick-lime should be sown over the land before the turnips come up. Two or three quarters are sufficient for this purpose, but as the caustic quality of the lime is destroyed by rain, the safest way would be to sow the three quarters at two or three different times.

By the 14th of July, the vetches and the first cutting of clover will be finished. The sheep and fold are then to be moved to the summer vetches; or to the second cutting of clover, which ever may be ready, and can be most conveniently brought into use. The vetch land, as it is cleared, should be ploughed and made ready for wheat, except it should not be quite cleared of twitch-grass. In that case the lands should be set up, water-furrowed, and remain for oats; and then there will be two crops of wheat only, and two of oats, in the eight years.

At this period (October 25,) the vetches and clover will be finished, and the fold then will be removed to the cabbages. They must be cut off and given to the sheep in troughs, which should be swept out clean

twice every day, and the fold to be moved on as before. The stems and roots of the cabbage must be dug up and carted to the compost heap. The land, if dry, as fast as it is cleared, should be ploughed and prepared for barley in the spring.

By this time, (the 22d of January,) the sheep will have eaten the cabbage, and require to be removed to the common turnips. But it might be more prudent perhaps, to take them off a fortnight sooner, and make a reserve of some of the cabbages, as in case of a hard winter, or heavy falls of snow, they are easily cut and carried to the stock. The largest of the turnips should be pulled up at intervals, when the days are dry, or when they can be most readily cleared of the dirt, and piled or stacked as they are drawn, in about half-ton heaps, in the form of a cone, enough to last the stock for about a week or ten days. Observe to keep the middle of the heap the highest, with the tops on the outside, which will protect them from the severity of the hard frosts. By adopting this plan, the sheep are more regularly supplied with food, which is a recompense for all the labour, even if they are thrown over the land again as the stock require them; but the best way is to chop the turnips and give them to the sheep in troughs, in the same manner as I have before directed on Swedes.

In the common mode of folding, the waste of turnips in some winters, from the alternate changes in the weather, is excessively great. If a frost set in, and the snow falls on turnips that are bitten, or have been bruised by the sheeps' feet, when the frost breaks up

again, they all perish. The dropping of their excrement and urine on their food, naturally disgusts them; and though they may seem to thrive for three days, they are nearly starving the remaining part of the week. But I need not enlarge upon this subject, as every farmer knows that regularity and good nursing, are as requisite in the fattening of stock, as good food.

I have stated, in another part of this work, that when my own stock was fed in the common way, on large breaks, and part of it in a confined fold with a shelter, with their food cut and given to them in troughs; the difference in the weight, they accumulated in winter only, was upwards of 7 or 8lbs. per quarter,

I have been told that it is a common practice in some parts of the country to give the sheep corn whilst they are eating turnips; and that a still more general custom prevails in most other parts of filling racks set in the breaks, with hay. I have tried both corn and hay on a small scale, but I never found any sheep do better than when they eat plentifully of cut Swedes, and had a little barley straw to pick at; and at the same time had plenty of that straw also to lay upon. I believe that barley straw assists the organs of digestion, and that the animals, whilst eating it, retain the succulent vegetables longer on the stomach, and in consequence acquire more nourishment from them, than they do when eating hay or corn; and it is advisable at all times to give the stock an opportunity of taking the food that is the least costly, particularly if nature

directs them in their choice. And I do know, from my own experience, that sheep may be made nearly as fat on cabbage, or Swede turnips, as they can be on corn, and I believe in nearly as short a time; and where corn is given, it often indicates a bad breed, or bad management, or both.

I shall conclude this chapter by stating the labour that is necessary in raising the crops, &c. &c.—The only extra implements that are wanted for the wide-row culture, is a good horse-hoe, and a proper plough for moulding up the rows. The first should be a light wood frame of a triangular form, with stilts for a man to guide it, and a light iron-bound wheel, about 30 inches in diameter, to run before the frame like the wheel of a barrow. The frame should hold three steel shares, of a semicircular form, set rather triangularly, for working three rows at a time; and, as cabbage and potatoes are generally planted wider from row to row, than wurzel or turnips, two sets of shares to fit the rows, will be required. The man who guides the hoe may work it deeper or shallower, as required; and in the second or last process, if wanted to work four or five inches deep, the frame may be weighted. If the land have become dense from heavy rains, or has not been sufficiently worked before it was planted, a scarifier with from three to five narrow steel coulter, fixed in the same beam, may be usefully employed before the hoe. Three coulters should be worked in each of the narrow spaces, and five in the broad ones; and if any clods are thrown up either with the

hoe or the scarrifier, they should be broken by hand. The crops must be hand-hoed, as often as the weeds appear in the rows, and when the weeds are eradicated, and the soil is sufficiently pulverized, the next process is to mould up the plants. This is sometimes performed by the double-expanding shelve-board plough, commonly drawn by two horses; but Mr. Brown's one-horse plough is a more preferable instrument for that purpose.

As every farmer knows the season for sowing, I shall only advert to a few particulars on that head. I have before said that Swede turnips do not attain to their highest state of perfection until the spring months and that they should be pulled up as soon as the bulbs, at least the largest of them, are come to their full growth, and carted to the grass land to be consumed by the stock; but in this branch of husbandry, it will be more expedient to cart them to the rye-field. There are several ways of preserving this crop; some cut off the tops and roots, and throw the bulbs promiscuously into heaps or stack them in buildings. Others draw and cart them with their tops and roots on, to a croft or grass field, and pave them, as it were, close together, with the tops uppermost. Both wurzel and Swedes have been buried in the earth, as potatoes are preserved, but they do not come out of the bury again so sound, nor so good in flavour as when they have been exposed to the free operation of the atmosphere. I have tried all the above methods, and I prefer and recommend the grower to place the bulbs in ranges,

about three feet wide, and four feet high, leaving the tops on for the outside course, and placing them outwards, and filling up the middle of the range with bulbs, having the tops and bottoms carefully taken off. If the bulbs are dry when they are stacked, and the ranges are covered so as keep out the wet, they will keep good and fit for use until June or July.

I have before observed upon all the advantages that can be derived from alternately changing the seed in every species of the deep and shallow-rooting plants. When any species of seed is good of its kind, the farmer cannot do better than raise his seed from his own plants, until he is well assured he has found a better sort ; and even then he should proceed with caution, and not sow too great a breadth in one season, until he is sufficiently convinced that by changing his seed he has improved his crops.

There are three sorts of wurzel, the red, the white and the yellow ; but the former is more generally used in this part of the country. Of turnips, there are a variety of sorts ; some years back, the tankard and the red and white Norfolks were the favourites, but from the bulbs growing high above the ground, they were liable to decay by a change of weather, or wet and frosts, they are only suited for early eating. The stone-turnip has a small top, is a quick grower, and as it runs deep into the ground, it is a preferable plant for late sowing. Some farmers select the Dutch sort, both for late sowing and late eating, which on account of the flat form of their bulb, that projects but

little above the ground, is less liable to be injured by the piercing frosty winds, and often endures the winter better than the stone-turnip. But the best sort that I know, for producing a general crop, is a hardy small-topped sort, with a round bulb, which may be described as a cross between the globe and the Swede. I raised this sort by planting a row of each close together in my garden, and selecting my seed turnips from their produce. This is a proof, if any were wanting, that the choice sorts cannot be kept pure, if two or more varieties be planted for seed near to each other.

Cabbages of various sorts are also planted for the consumption of sheep and cattle, but those most commonly grown for that purpose, are the large Scotch, the large Battersea, and the drum-top, and of these sorts, I should prefer the latter. The seed is most commonly sown in beds, the first or second week in August, for autumn or early spring planting; but if the seed be sown as early in the spring as the ground can be worked, the plants will be large enough for setting out in May or June.

To the system which I have just pointed out, I imagine that some farmers would object, because it would require a greater capital to carry it into complete effect; but in fact, that argument ought not to be admitted against the principle of the system, for if the occupier be straitened in his means, the plan I have recommended should only be entered upon partially at first, and than be progressively advanced as

he can command the capital to appropriate to that purpose ; and here let them not lose sight of the old adage, that to do a little business and do it well, is much better than doing a great deal when it is but ill done.

The paramount object with the mercantile capitalist, is the per centage on his returns, but he can extend or curtail his business according to his profits ; but it is not so with the grazier who employs a large capital, as he is confined to one return in a year, and at the best of times at a moderate rate of interest ; and the only latitude he has to improve his profits in this branch of his husbandry, is by breeding or purchasing the best kinds of stock.

I have lately observed, that the arable farmer may make two returns with his sheep and cattle, in the year ; and there is another thing which I trust I may be permitted again to repeat, that the roots and fibrous matter left in the land from cultivated plants, tend much to enrich the soil on all land, and this on heavy land is a great acquisition, as it prevents it from falling or becoming dense ; nor need I perhaps, state the great advantages which are derived from growing two crops which do not exhaust the land, instead of one.

Supposing the 240 acres of arable, in the former estimates, to have been under the customary course of husbandry, and much reduced in fertility, and to require manure for 30 acres annually, for the first eight years, then the extra capital will be £1,050.; or as follows :—

	£.	s.	d.
3 Horses extra, harness, implements and provender, £33. each, or....	100	0	0
500 Sheep do. or 47 oxen, and 150 do.	750	0	0
Manure for 30 acres, at £5. per acre ..	150	0	0
Extra seed, say.....	50	0	0
	<hr/>		
	£1,050	0	0
	<hr/>		

But I should further remark, that no outlay will be required for manure, after the first course of eight years, except occasionally for lime, and that the manure from the yard should be wholly applied to the green crops. The expense, of course, will chiefly depend on the distance which the farmer has to cart the manure. Bone-dust, Horn-shavings, Nitrate of Soda, &c. &c., may be much cheaper than dung, when he has a long way to carry it.

Writers on Agriculture, generally treat the subject too definitely, by adopting the axiom that it is impossible to lay down any rule in farming that will suit all soils in all seasons ; and farmers have too frequently fallen into the same error. All crops are alike subject to be affected by the variations of the seasons, and land should be planted with that species of crop which past experience has proved to be most profitable ; but this is no reason why green crops should not be thrown in between the corn crops. All land that will grow good crops of clover will also grow good crops of wheat ; and land that will produce good crops of barley, grow any kind of green crop. If the climate, or soil, be too damp for the potato-oat,

others of the same species, but of a more hardy kind, should be sown. Any land that will carry good crops of oats, will also bear green crops of one sort or other; and that sort which experience has proved, on an average of seasons, to be the most profitable, should be planted.—If land be too wet for the deep-rooting plants, it may be possible to drain it; or if the fault be in the sub-soil, which is mostly the case, it may be improved by breaking into the substrata as before mentioned. That sort of land which is found, on the average of seasons, to produce more profit in oats than in barley, should of course be sown with oats.—If any land be too damp for the black oat, or other hardy plants, it should be laid down in meadow, or cropped with willow, or some other aquatic plant.

Some species of plants fail, at times, from the hollowness of the soil; when that is the case, the land may be improved by a dressing of calcareous earth. Heavy loams, or clayey land, when well managed, often grow the best crops of cabbage, and even roots of some descriptions; but this sort of land is generally ploughed with a furrow much too wide, and the consequence is, that it is not then possible to reduce the mould fine enough for planting; or if this be practicable, it always takes a much greater portion of mechanical labour to reduce it, than if it had been ploughed with a narrow-furrow. A slice from five to six inches wide, or even narrower if required, may be cut and turned by a plough made upon Mr. Brown's principle, and can be worked by two horses be

the ground ever so hard. If a field be of two or more kinds of land, that is better adapted to grow two sorts of grain, they are readily kept apart by drilling in the crops, and leaving an interval between them.

An opinion prevails among many of our farmers, that the oftener they change the species of plant, the less the land is exhausted, under the idea that one crop takes one sort of food out of the land, and that others feed on another sort; but this is not the case with regard to the food, for if land be once exhausted of its putrescent matter, every species of plant will become sickly, or dwarfish, alike. But, if manure be applied to the land, all vegetation will become healthy again, and even weed seeds that have been suffered to remain in the land for centuries, will thrive as well as the cultivated plants; in the same manner as an animal requires a sufficient quantity of food to raise it to its full or natural size. Still, a change of species is necessary for various reasons. First, a proper interval of time is often requisite to prepare the land for a succeeding crop; and secondly, as the deep-rooted plants take a part of their food from the sub-soil, consequently more food is left in the surface-soil for those plants whose fibrous roots strike out horizontally.

CHAP. XXV.

ON BREEDING OF STOCK.

WITHIN the last eighty or ninety years, great exertions have been made in most parts of the country, to improve the different Breeds of Farming Stock ; and such has been the success of those patriotic individuals who have employed their time, talent, and capital in this laudable pursuit, as to entitle them to the gratitude of their country. At no former period, nor in any country, has stock attained to such pre-eminence, nor has it ever been so well adapted to the soil and climate which it has to inhabit, as it is in this country at the present time. Still however, much remains to be done, particularly amongst the middling and ordinary kinds. But when we look round and see so many institutions to encourage the improvement of stock, and other rural concerns, patronized by Noblemen and other Gentlemen of wealth and talent engaged in this great national object, we may anticipate that the day is not far distant when we shall see each species and character of stock advance much nearer to perfection.

The greatest improvements, combining both theory and practice, in that most important branch of farming, seem to have emanated from that celebrated breeder, the late Mr. Robert Bakewell, of Dishley, whose memory, like the Poet of my native county, will be immortalized by his successful and unrivalled talents. His theory, at the time of his decease, was well understood by a few students who were fortunate enough to have been instructed by such an able and distinguished master, and it was by them its rudiments were communicated to others. Men of enlightened minds and of superior knowledge, eagerly caught the ideas of the great founder, and improvements, though they have advanced but slowly, have ever since that time, been progressive. The soundness of his judgment was engrafted in the principles of his practice, and that practice will never be lost sight of or forgotten. Though eminently successful in his Sheep, he does not appear to have been quite so fortunate in his Cattle.

Mr. Bakewell, directed his studies, first to selection, and then to the putting together of the best males and females. As he approached towards perfection, his practice was to follow what is termed in-and-in-breeding. The same practice has been successfully followed by others to some extent, and some individuals have continued to make improvements gradually in their stock since that period, although they have confined themselves wholly to their own flocks; whilst there are others, though men highly gifted in

talent, who have not been so successful in pursuing the same system ; but this might have arisen from a defect in the materials of which their fabric was first commenced.

Constitution, which embraces both external and internal formation and structure, is the chief corner stone necessary to the production of a perfect animal. In the construction of a good frame, the following qualities should be combined :—a deep and wide chest, which indicates a wide loin and hips, and the ribs should spring gradually wider until they approach nearer to the hip. The shoulder blades should project far towards the hinder quarters, which gives more surface on the chine ; this is considered an excellent point in animals intended for slaughter, as it enables them to travel with greater facility, and to accumulate more meat on that part where it is of the most value. This surface, while the beast is in store order, contains more lean meat, inasmuch as it approaches nearer to a circle than to an ellipsis, (or as an elevated ridge has a greater surface than its base,) and in consequence more substance is accumulated by the same thickness of fat, than on one of an ill-shape. The external, will necessarily correspond with the internal parts. The formation of the lungs will also agree with the chest in size and shape.

This subject, perhaps, will be better understood if I quote Mr. Cline's own words :—"The external form of domestic animals has been much studied, and the proportions are well ascertained ; but the external

form is an indication only of internal structure." In order to obtain these important qualities, we must first consult nature's laws, and then be guided by experience and observation. And perhaps, I cannot better illustrate this position than to point out to the reader what must have frequently come under his observation as well as my own, namely, that when we enter a fair early in the day, we commonly see good and bad stock of all denominations and characters intermixed, but extreme defects, in this part of the country, are more predominant in other stock than in sheep; and though these observations may be applied, in principle, to the whole, I shall confine myself to neat cattle. The best are generally the first in demand, and at the latter end of a fair we seldom find any thing else left than a herd of starvelings; and if we inquire of the person who bred them the cause of their ill shape and diminutive size, he will tell you that they were always underlings, and the master-stock got the most and the best food. This in part might be true; but as they had all been depastured together, and had been of the same size, had they been of the same form and make, there would have been no mastership or difference in value, the cause was a defect in constitution, of the dam or sire, or both; or if both dam and sire were alike in make or form, or if the bull is of larger growth than the cow, the offspring will degenerate from both in form, and probably in constitution. The breeder in order to defend himself from the observations that a purchaser may make on his stock, will give their pedi-

gree, and perhaps at last trace them till he shews they are descended from the most eminent stock of the present day ; and if they be young, he is sure not to forget to assert that they are sure to be big ones, as he always procured his bull from the largest stock he could find. I have frequently observed that the small farmer and the cottager, seldom breed any good stock, in consequence of falling into the error to which I have just alluded ; and I could produce a number of instances to prove, from an early period of my own experience, that to endeavour to improve stock by a larger male than female, is a most dangerous experiment.

“ When the male is much larger than the female the offspring is generally of an imperfect form. If the female be proportionally larger than the male, the offspring is of an improved form. For instance, if a well-formed large ram be put to ewes proportionally smaller, the lambs will not be so well shaped as their parents ; but, if a small ram be put to larger ewes the lambs will be of an improved form.

The principles of improving it, must therefore be founded on a knowledge of the structure and use of internal parts. The lungs are of the first importance. It is on their size and soundness that the strength and health of an animal principally depend. The power of converting food into nourishment, is in proportion to their size. An animal with large lungs, is capable of converting a given quantity of food into more nourishment than one with smaller lungs, and therefore, has a greater aptitude to fatten.

THE CHEST.

The external indication of the size of the lungs, are the form and size of the chest; the form of which should approach to the figure of a cone, having its apex situated between the shoulders and its base towards the loins. The capacity of the chest depends on its form more than on the extent of its circumference, for where the girth is equal in two animals, one may have much larger lungs than the other. A circle contains more than an ellipsis of equal circumference, and in proportion, as the ellipsis deviates from the circle, it contains less. A deep chest, therefore, is not capacious; unless it is proportionally broad.

THE PELVIS.

The pelvis is the cavity formed by the junction of the haunch bones, with the bone of the rump. It is essential that this cavity should be large in the female, that she may be enabled to bring forth her young with less difficulty. When this cavity is small, the life of the mother and her offspring is endangered. The size of the pelvis is chiefly indicated by the width of the hips and the breadth of the twist, which is the space between the thighs. The breadth of the loins is always in proportion to that of the chest and pelvis.

THE HEAD

The head should be small, by which the birth is facilitated. Its smallness affords other advantages,

and generally indicates that the animal is of a good breed.

Small bones indicate fattening qualities."

Having thus treated on the formation, and internal structure, it is now necessary to inquire into the effect of this constitution ; secondly, to point out the means of obtaining these qualities in the inferior stock of the same character ; thirdly, how it is to be obtained by crossing with the same species of a different character ; and fourthly, how it is to be detained or advanced in those breeds that have been improved. We find that it is these constituted powers that enable an animal to take more food into the stomach ; and extract more nutriment from a given quantity, than one of less muscular power. Thus more meat, more milk or cream, or more wool, are obtained from a given quantity of vegetables, by the well constituted animal than by the one less perfect in its formation.

"The proper method of improving the form of animals, consists in selecting a well formed female proportionally larger than the male.

The improvement is on this principle, that the power of the female to supply her offspring with nourishment is in proportion to her size, and to the power of nourishing herself from the excellence of her constitution. The size of the foetus is generally in proportion to that of the male parents ; and therefore, when the female parent is disproportionally small, the quantity of nourishment is deficient, and her offspring has all the disproportions of a starveling. But when the

female, from her size and good constitution, is more than adequate to the nourishment of a foetus of a smaller male than herself, the growth must be proportionably greater. *The larger female has also a greater quantity of milk*, and her offspring is more abundantly supplied with nourishment after birth. To produce the most perfect formed animal, abundant nourishment is necessary from the earliest period of its existence until its growth is complete."

To illustrate these positions of Mr. Cline, I think I cannot do better than begin with a history of the stock of that celebrated breeder, the late Mr. Webster, from which the Dishley, the Rollright, the Croxall, the Warwick Park, the Snitterfield, (which is now one of the oldest long-horned breeds in this county,) and all the first-rate long-horned cattle are descended. This I am enabled to do, partly from my own knowledge of the facts I shall advance, and partly from the information that I have obtained from others.

Mr. Webster, whose indefatigable and successful labours in the improvement of cattle, entitle him to be ranked with the benefactors of his country, occupied one of his own estates, a rich grass farm, at Canley. He commenced the difficult and arduous task of the improvement of cattle-stock about the beginning of the last century, and continued the pursuit, with undiminished ardour, until his decease, sometime about the year 1760. His stock were famed for their large frame and great constitutional powers, for their inclination to fatten, and their quantity of milk.

At that time, Mr. Webster's stock was admired for beauty as well as size. Theory in breeding had then never been thought of, and large bones and a great head were considered an excellence, and not a defect. His stock was remarkably wide over the loin and hips, and a deep chest; but what seemed most to attract the notice of some of his visitors was, their remarkably long crooked horns and their fat rumps. I am now speaking of a part of this stock which was bought at Mr. Webster's sale after his decease, and which I have exhibited to visitors. Auction sales were not very common at that time, and my grandfather was appointed by the executors to sell the stock. I have heard my father and others express their great astonishment that Mr. Webster could keep his stock from degenerating, when there was no other breeder in the kingdom to which he could go for a cross or a change of blood, or for any improvement; yet he gradually kept improving them both in form and size. Chance sometimes has effected that which all the labour and study of man has not been able to accomplish; but observation, directed by judgment, is sure to lead us to useful knowledge.

I shall now advert to the manner in which Mr. Webster reared his calves and kept his young stock. I occupied a part of his farm, and superintended another part since his decease; when together, it was an excellent dairy and stock-farm, and I do not know any land that will force young cattle to a greater size. His calves were always nursed on the cow until they

were six or seven months old, when they were fed with hay and herbage in the best manner the farm would afford, and by this method his females increased in size in proportion to his large males, and thence his cattle attained those high constitutional powers which they possessed, and at that period they were allowed to be the most perfectly formed large breed of stock in the kingdom.

A Mr. Baseley, at that time, was in the habit of purchasing heifers of Mr. Webster, but Mr. Bakewell always had the first selection; he often visited Canley, and sometimes gave the former a commission to tempt Mr. Webster by offering him a high price for some of his favourite stock. The price then was about 20 guineas each, but some years before Mr. Webster's death, Mr. Fowler, became a purchaser, and then his cows rose to about 30 guineas each. Mrs. Webster had the sale of the bull-calves, and they were generally bespoke at from three to five guineas each, before they were dropped.—Hence arose the famous Dishley, Rollright and Croxall stock.

Mr. Bakewell's bulls were of a smaller size, and highly capacitated to reduce the bone and head of the Canley breed; but one of his grand efforts was to produce cattle that gathered their flesh while feeding, level on the back, and which he termed his machinery for converting vegetables into human food. He made another singular observation, having for its object the advancement and completion of his favourite system; he compared his feeding stock to a corn-mill, and him-

self to the workman who understood the cutting and setting of the mill, and that which made the most meal and the least offal he called the best machinery.

Mr. Fowler was in the habit of hiring bulls of Mr. Bakewell. His favourite cow stock at the time of the sale was by *Twopenny*, the sire of *Brindled Beauty*. *Nell*, and several others was knocked down in my name for 360 guineas. Several others, of different ages, were also knocked down to my biddings at upwards of one hundred guineas each. (*See the Roll-right Catalogue.*)—This sale took place a few years after I commenced business at Cubbington; and as I was personally known to Mr. Bakewell and some of the Leicestershire breeders, I was solicited by one of them to take a commission to purchase for him, or a company. Having accepted the offer, when the sale commenced, I bid for the respective lots, agreeably to a signal previously agreed upon between myself and my friend; the Gloucestershire and other breeders, however, having discovered that a preconcerted opposition was in active operation against them, the signals were discontinued, and the biddings became more spirited, and the purchasers of course more general.—The prices may still be seen in the catalogue.

There is one other circumstance which came within my own knowledge, and as it is connected with the present subject, I shall introduce it here, without making any further apology. I have before stated, that the once-famed Warwick Park stock was descended from stock purchased at the Canley sale. The late

Mr. Joseph Hiorns, whom I succeeded at Cubbington Heath, purchased heifers at a large price, at different times, about the year 1770, immediately descended from the latter stock; he used no other bulls than those of the same breed and blood, until about the year 1786, when his stock was valued to me by Mr. Palfrey, whose judgment then stood very high as a breeder, and in the valuation of stock. The average price of the one and two-year olds did not exceed £8. a-piece; and others of the young cows were valued at about the same proportion. The stock were diminished in size, were ill-formed, and had lost, to a certain degree, their constitution, which deterioration, at that time, was wholly attributed to the want of permanent pasture and meadow land, and that that newly inclosed farm was not calculated to carry such large stock. This, to some extent, was doubtless a proper conclusion, and might have been borne out in fact, but if the calves had been well reared, so as to have got an early start, although the farm was not so well suited to the growth of cattle as Mr. Webster's, if Mr. Hiorns had taken the reverse course, after he had reduced the size of his females to what he had, and had selected his males from a smaller breed, with good constitutions, instead of having endeavoured to raise the size of his breed by a larger male, I have no doubt but he would have succeeded, and that his stock would have been of a much greater value.

I occupied that farm for more than 30 years afterwards, and though it was not so well adapted as many

others to raise large stock, I reared some very good cattle of a moderate size, and I could have produced larger ones, had I nursed the females with roots and vegetables. I have often sold breeding ewes from 5 to 10 guineas each ; and at my first sale of rams, I was offered by a nobleman and two Irish gentlemen 1000 guineas for 100 breeding ewes, which I did not accept. As we were afterwards walking through the flock of nearly 200 ewes, one of the same gentlemen remarked that there could be no choice in the selection, for he could perceive no more difference in them than he could see in the beans that were sifted for his horse.

The reader, I hope, will excuse me for the strong caution I have given him against falling into this fatal error in breeding, which I excessively regret to observe is but too prevalent in the present day. Though it must be admitted great improvements have been made by some breeders, yet the generality of the ordinary sorts, are become worse, owing to the owners attempting to gain size by a large male.

By what I have said, experimentally, on the raising of good and large stock, the breeder will perceive that a common portion of expense and judgment, with an incessant perseverance, and unremitting care and attention in selecting and putting together of stock, will accomplish wonders ; and if it do not raise a man into eminence much above his neighbours, as a breeder, it will always repay him on the score of profit, both in breeding and feeding ; rank his name high in that respectable class of society as a man of judgment and

discernment ; and he will, moreover, receive an ample reward for all his labour, in the self-gratification that he will derive from his success. I trust I have pointed out in what way good stock may be reduced and brought to ruin, and I cannot dismiss this subject without remarking, that—They who neglect the means, will never accomplish the grand object sought after, which is—*breeding and rearing good, if not superior stock,*

The *inferior* breeds of cattle, in the midland counties, generally, have been retrograding ever since my memory was strong enough to make an observation upon the fact ; and they have now degenerated so low, through all their varieties, that they are not only become a disgrace in the fine districts in which they are bred, but a real calamity to the community. I shall, therefore, attempt to point out an easy and practicable way in which the *ordinary* stock of the country may be improved,

The North Devons and the North Scots, have retained their constitution and form more perfect, perhaps, than any other cattle in the whole kingdom ; but if we trace them further into the different parts of the country, where the soil and climate are more favourable to feeding, we shall find in the hands of some few breeders, an improvement, both in size and aptitude to fatten, and retaining at the same time their original constitution and formation. Yet in general we find that these good qualities have been lost, and the original stock has been succeeded by a race of starvelings of different sizes. The true cause

of this degeneracy, I have already pointed out ; and to recover their original qualities, the breeder must retrace his footsteps, and by the use of a well constituted male, in these more kindly situations, time will work with the judgment of the breeder, to raise a large and healthful race of animals. The breeders of this worthless stock are chiefly to be found among the smaller farmers, who seldom travel farther from home than to the nearest market-town, or to some of the local fairs. Yet even these persons, if instead of lamenting over the low prices of their stock, were to bestow that time in comparing their own with the better judgment of some of their more opulent neighbours, would obtain many useful and profitable lessons in the heart of breeding. And let those who attribute the greater value of the stock of the same year solely to the advantages that his neighbour possesses, by holding better land, not suffer themselves to be told more than once—that the breed of an animal does not go in at the month,

That writer, I am perfectly aware, who finds fault with his neighbours for following the practice of their forefathers, which has been handed down to him confirmed by the custom of ages, even if he pointed out an easy, economical and permanent remedy, must expect to be rewarded, in some instances, with but scanty praise. Yet few men, I think, will be found in a whole district, to continue a bad system, either in breeding or seeding, when they see how far they are thrown into the back ground by their more tractable and more rational neighbours. My object, as I have proceeded, has been

to notice defects in systems, and errors generally in popular practice ; and when I have done so, and directed in their stead, a safe and evident improvement, it then becomes the province of others, as they will reap the benefit of the change, gradually to bring those improvements into practice.

I have long considered that the degenerated stock now in use by many small farmers is a public loss ; and all my observations latterly, have confirmed me in this opinion. To remedy this evil, I would recommend the great landed Proprietor, to import into his parish, for the purpose of improving the cattle stock of his poorer tenantry, a male of that species possessing all the good qualities which I have before described. The advantages would be reciprocal, and the improvement would be gradual and certain, and what is at this time a consideration of some importance, a great advantage would be obtained at a very trifling expense. This would renovate the whole of the ordinary cattle stock of the country, and consequently increase their value whether destined for the shambles or the pail.

A neat male, for this purpose, might be easily obtained from the north of Devon ; and while I am speaking of that beautiful and peculiar species of cattle, I will lay down to the reader, some of the principal external characteristics by which that breed is distinguished, which will show to them at once, in what manner the breeders in that county have kept the breed pure and unmixed from age to age down to the present moment. In the North of Devon (for the

breed is exclusively confined to that district,) they never rear a calf for breeding that is not *self-coloured* (a red or liver colour) throughout ; a calf with white hair under the belly or on the brisket, a bushy head, a smoky face or tail, a blue nose, or even a party-coloured hoof is not admitted into their breeding-stock. They are a hardy race, and though their skin is remarkably thin and soft, they endure the severe winters of that bleak hilly county in a surprising manner.—To select a bull for the improvement of stock in this part of the country, the purity of his colour would be of but little consequence.

A more hardy, and an animal perhaps, equally as complete as the Devon, may be had towards the north of Scotland. The improved Galloway or Kyelow, if judiciously used, are capable of improving any of the ordinary breeds in the kingdom.

I believe I may say, without fear of contradiction, the finest and best large stock-cattle we have now in the island, are those descended from the breed of the late Messrs. Collins ; and from which the stock of the noble Patron of the Smithfield Cattle Club, and of many others, were selected and improved, by those enlightened breeders, within my memory. At the time the Smithfield Club was first established, the Durham and North of England cattle were pointed out by the late Mr. Wilks, to shew the necessity of such an institution ; and the stock from the north of England exhibited that day in the London Christmas market, was a disgrace to the country from whence they came ;

and after that period, in a conversation with Mr. C. Collins and others, when speaking of the original improvements of the Dishley stock, Mr. C. observed that much good might be done in Yorkshire, by a choice collection of their native cows with a good Scotch male. I do not know whether Mr. Collins ever acted on this suggestion, nor have I seen the Herd-book, so that I cannot determine that point.

But, if we were to attempt to trace the great benefits that the public have derived from this Institution, we must not stop prematurely at the improvements that have been made in the Durham and Yorkshire stock. The Southdown sheep, for instance, is quite an improved animal now, to what it was at the time to which I allude. That enlightened breeder, Mr. John Ellman, first laid hold of the proper rudiments in the science of breeding, by attending these exhibitions, and was heard to remark then, that the Southdowns were equally as well constituted as the Leicesters, but they required selection and a further improvement in their formation. Since the late Francis, Duke of Bedford, and Mr. Coke, now Lord Leicester, and other noble and patriotic gentlemen have exerted themselves so unceasingly, in promoting the best interests of agriculture, in every department, that coarse, horned, and unthrifty breeds of sheep, then the general breed in Norfolk, Wilts, and other southern and eastern counties, and in some other districts, have nearly all disappeared, and are replaced by the more profitable breeds, the Southdowns, and Leicesters. And if we add

to these the great improvements that have been made in agricultural implements of almost every description, as well as in the cultivation of the soil, no one can deny that a wonderful public benefit has been effected by these Institutions; although many other improvements may yet be made in the inferior sorts of agricultural machinery.

Before I quit this interesting subject, I will again warn those breeders who are so anxious to obtain large stock, not to breed them of a spurious sort. The rage for Durham cattle throughout the midland counties is now become very great, and as the demand in the southern districts draws them from the north, the small females are put to the large males in order to increase their size. The chief bulk of those which are brought into this county, (Warwickshire,) or that pass through it, are worthless animals, having long legs, small breasts, narrow backs, small chests, and flat sides, with more or less of those other bad qualities, with which these defects are generally accompanied; and probably the larger they are, the more incompetent they are to convert, profitably, vegetables into human food.

I was present lately when some cattle of the above description were purchased of a Yorkshire jobber; they were two-year-olds, and were bought at £12. a-piece. A second drawing was made by another person, and they were bought at less money. They had shorter legs and backs; their breasts wide and projected farther, and in consequence the chest was in

a better form, by their shoulder blades falling more into their backs; and as they were more muscular animals, they of course had a greater surface of meat to cover with fat; and although these were not good ones, they were, in my estimation, of much greater value than the former. I am well convinced that this mode of breeding has done a considerable deal of mischief, as far as the public are concerned, and if not speedily checked it will be the source of still greater evils. If the size continue to attract the notice of some purchasers of middling stock, yet there is no want of customers for the best and at higher prices.

The following observations are worthy the attention of all breeders of stock:—

“It has been observed, in the beginning of this chapter, that the power to prepare the greatest quantity of nourishment from a given quantity of food, depends principally on the magnitude of the lungs, to which the organs of digestion are subservient.

To obtain animals with large lungs, crossing is the most expeditious method, because well-formed females may be selected from a variety of a larger size, to be put to a well formed male of a variety that is rather smaller.

By such a method of crossing, the lungs and heart become proportionally larger, in consequence of a peculiarity in the circulation of the foetus, which causes a larger proportion of the blood, under such circumstances, to be distributed to the lungs than to the other parts of the body; and, as the shape and

size of the chest depend upon that of the lungs, hence arises the remarkably large chest which is produced by crossing with females that are larger than the males.

The practice, according to this principle of improvement, however, ought to be limited, for it may be carried to such an extent that the bulk of the body might be so disproportioned to the size of the limbs, as to prevent the animal from moving with sufficient facility. In animals where facility is required, this practice should not be extended so far as in those which are intended for the food of man.

ON THE CHARACTER OF ANIMALS.

By character in animals, is here meant, those external appearances by which the varieties of the same species are distinguished.

The character of both parents are observed in their offspring, but that of the male more frequently predominates. This may be illustrated in the breeding of horned animals; amongst which there are many varieties of sheep, and some of cattle, that are hornless. If a hornless ram be put to horned ewes, almost all the lambs will be hornless; partaking more of the character of the male than of the female parent.

In some counties, as Norfolk, Wilts, and Dorset, most of the sheep have horns. In Norfolk, the horns may be got rid of by crossing with Ryeland rams; which would also improve the form of the chest, and the quality of the wool. In Wiltshire and Dorsetshire

the same improvement might be made by crossing the sheep with Southdown rams.

An offspring without horns might be obtained from the Devonshire cattle by crossing with hornless bulls of the Galloway breed, which would also improve the form of the chest; in which the Devonshire cattle are often deficient.

A Kyelow bull would be a proper animal to improve the Alderney breed, being more hardy, and having a wider chest; although it is the largeness of the chest that enables this stock to convert more nutriment from a given quantity of vegetables than most other stock do; yet the Kyelows would improve the chest by bringing it nearer to a circle than an ellipsis; give them more muscular power to accumulate meat; and in the hands of a skilful breeder, might become the best breed of small animals in the Island.

EXAMPLES OF THE GOOD EFFECTS OF CROSSING THE BREED.

The great improvements of the breed of blood horses in England, arose from crossing with those diminutive stallions the Barbs and Arabians; and it is said, the introduction of Flanders mares into this country, was the source of improvement in the breed of cart horses.

The form of the swine has also been greatly improved, by crossing with the small Chinese boar.

EXAMPLES OF THE BAD EFFECTS OF CROSSING THE BREED

When it became the fashion in London to drive

large bay horses, the farmers in Yorkshire put their mares to much larger stallions than usual, and thus did infinite mischief to their breed, by producing a race of small chested, long legged, large boned worthless animals.

A similar project was adopted in Normandy, to enlarge the breed of horses there, by the use of stallions from Holstein; and, in consequence, the best breed of horses in France would have been spoiled, had not the farmers have discovered their mistake in time, by observing the offspring much inferior in form to that of the native stallions.

Some graziers in the isle of Sheppey, conceived that they could improve their sheep by large Lincolnshire rams, the produce of which, however was, they were much inferior in the shape of the carcass, and the quality of the wool; and their flocks were greatly injured by this attempt to improve them.

Attempts to improve the native animals of a country, by any plan of crossing, should be made with the greatest caution; for by a mistaken practice, extensively pursued, irreparable injury may be done.

In any country, where a particular race of animals has continued for centuries, it may be presumed that their constitution is adapted to the food and climate.

The pliancy of the animal economy is such, as that an animal will gradually accommodate itself to great vicissitudes in climate, and alterations in food; and by degrees, undergo great changes in constitution; but these changes can be effected only by degrees,

and may often require a great number of successive generations for their accomplishment.

It may be proper to improve the form and quality of meat or wool of a native race, but at the same time, it may be very injudicious to attempt to enlarge their size.

The size of animals is commonly adapted to the soil which they inhabit.

Where produce is nutritive and abundant, the animals are large, having grown proportionally to the quantity of food, which, for generations they have been accustomed to obtain. Where the produce is scanty, the animals are small, being proportioned to the quantity of food which they were able to procure. Of these contrasts, the sheep of Wales and Lincolnshire, are examples. The sheep of Lincolnshire would starve on the mountains of Wales.

Crossing the breed of animals, may be attended with bad effects in various ways; and that even when adopted in the beginning, on a good principle; for instance, suppose some larger ewes than those of the native breed, were taken to the mountains of Wales, and put to the rams of that country; if these foreign ewes were fed in proportion to their size, their lambs would be of an improved form, and larger in size than the native animal; but the males, produced by this cross, though of a good form, would be disproportionate in size to the native ewes; and therefore, if permitted to mix with them, would be productive of a starveling ill-formed progeny.

And this was the case in the Flanders mares above alluded to; they were of a larger size than the stallions of this country, and in the first cross, promised great and permanent improvement in the breed of cart horses and their progeny became circulated in almost every part of this country and has been the source of a great evil, which has not been wholly counteracted even to the present day; though this introduction of the Flanders mares took place upwards of sixty years ago.

Thus a cross, which at first was an improvement, by giving occasion to a contrary cross, ultimately prejudiced the breed. The general mistake in crossing, has arisen from an attempt to increase the size of a native race of animals; being a fruitless effort to counteract the laws of nature. The Arabian horses are, in general, the most perfect in the world; which probably has arisen from great care in selection and also from being unmixed with any variety of the same species; the males therefore have never been disproportioned in size to the females.

The native horses of India are small, but well proportioned, and good of their kind. With the intention of increasing their size, the India Company have adopted a plan of sending large stallions to India. If these stallions should be extensively used, a disproportionate race must be the result, and a valuable breed of horses may be irretrievably spoiled.

From theory, from practice, and from extensive observation, which is more to be depended on than either, it is reasonable to form this conclusion.

It is wrong to enlarge a native breed of animals, for in proportion to their increase of size, they become worse in form, less hardy and more liable to disease.”—*Mr. Cline.*

ON QUALITY.

The same conclusion may be drawn as respects quality; the small joints are the most saleable; the lean most interlarded with fat; and that of the firmest sort; in consequence the most nutritious. Though no one can deny but the nature of the food they are fattened with greatly affects the flavour of the meat; yet the finer the grain of the meat the less impurity it imbibes from a coarse or nauseous food; but the variations in quality, as well as quantity in large beef, often depends more on constitution than the nature of the food they consume. An animal with a sound well-formed internal structure, will accumulate more lean; and that of a finer grain, than one not so well constituted; and that when put to fatten, will also accumulate fat of the best quality and quantity, according to consumption of food, and its nutritious quality.

If the large sheep of this country were taken to the Lizard Downs, or Welch Mountains, if they could obtain their food with ease, and take their natural rest, no doubt the flavour of the mutton would be finer in proportion; as the native sheep of those countries deteriorate in flavour, when fed on the coarse grasses of this country. The excellence of a saddle of mutton is its deep cut of lean, and thick firm outside fat; and the same observations may be made as to the leg; the

twist or thigh part deep and broad, with lean down to near the hock ; and the thick part of the thigh and twist well covered with firm fat ; and these perfections may be traced to the constitution and internal structure.

If a sheep or an ox be more loaded with fat on the top of the hind-quarters in proportion to the fore-quarters, it is caused by internal structure, and is indicated by the breast not being broad, nor projecting forward. In a short breasted animal the shoulders are more upright, and for want of projecting more into the back the chine is narrower, and the fore-quarters lighter in proportion to the length and breadth of the breast. Again, when the chest is not proportionally wide to its depth, the lungs and heart lie further back from the stomach, occasioned by the shortness of the breast ; and thus, the soluble part of the food is forced by the organs more to the top of the hinder quarters ; and in sheep I have often observed the fat to be of a soft greasy nature. When the breast is both wide and forward, the back is also broad, and indicates that the structure is large and well constituted. In this case the organs work regularly, and convey the soluble matter from the stomach, through the system, and all parts accumulate alike.

This, perhaps, may be better illustrated by comparing the Chinese pig, with the Tonkay ; the former has a more circular chest, and wide forward breast, which indicates the internal structure ; by this we find, when they come to be fatted, they accumulate much firm fat regularly along the back, and from

the nose end to the hocks. But in the deep narrow chest of the Tonkay, we see their bellies dragging almost on the ground ; and though in this structure we find excellent nurses for their young, yet when they come to be fatted they send their fat to the belly part of the flitch, or to the internal parts, and that of a soft greasy nature, and accumulate very little fat on their backs compared with the Chinese.

The Alderney cow has also a deep chest, and of course large lungs and heart ; in consequence of the internal structure laying low the milk vessels are better supplied with the soluble matter of the food, which causes the milk to be more in quantity or richer in quality ; but when this stock comes to be fatted, they accumulate most on the lower part of their quarters, and in tallow in the inside ; very little firm fat gathers on the back, while a well-formed animal accumulates its weight regularly through the whole system. But one only partially so constituted, will accumulate its weight, or thickness of meat, partially also.

Pigs are an article of great commerce ; many persons breed them for the purpose of selling them as stores, and in this case it may perhaps be their interest to have them of a large growing sort, and this seems to suit the judgment and views of the dealer, who informs his customers they will make fine animals when fatted, for he knows the sire and he was bred from one of the largest hogs he ever saw. The persons who purchase those large, coarse, hairy, big-boned animals, do not

consider how much more valuable food they consume to raise a given quantity of human food, compared with the better constituted animals. I never fattened any of this kind myself, but from what I have heard from others, and the time they have taken in fattening, and the quantity of food they consume, they must be very unprofitable, when compared with the light-boned, fine-haired, thick-backed ones. I have more than once noticed the fattening of two pigs at about six months old each, against one of the same breed at twice that age, and always found I had more bacon from the two than from the one, in proportion to the food they consumed. It was from this fact, that I was first struck with the idea that great advantages arose from breeding stock that will ripen at an early age.

It is now about fifty years since I was first in possession of this breed. I bought them of Mr. Lines, of Kirkby; they had been procured by the late Lord Wentworth, from a London brewer, and were wonderfully quick feeders, and produced the most bacon for the food they consumed, of any sort I had before seen, and indeed of any that I ever heard of. Mr. Lines did not know how they had been bred, but they had a cross of the Chinese, and from what I have since seen of the Neapolitan, I have no doubt but their size was first obtained from a Berkshire sow and a Neapolitan boar, and their progeny crossed by a Chinese. They were light in the belly, with a remarkably thick chine and back, light hair, and small in their offals. They made delicate pork with very little corn

feed, and would weigh about fourteen score at twelve-months old, with about two-months feeding on potatoes and meal.

The weather becoming warm, I once kept two of this breed feeding through the following summer; and they were thought to be such a curiosity that people came from a great distance to see them. They were killed when they were about two-years old, and they weighed $22\frac{1}{2}$ score each.

I have sold many of these pigs to go into different parts of the country, when about two-months old, at from four to five guineas a pair. Some were purchased and sent into the Isle of Wight, and others were sent with sheep stock into Ireland. At that period, a great deal of stock, of different kinds, was purchased in this county and in Leicestershire, by gentlemen from Ireland to send into that country; and no doubt great improvements in the native stock of that Island, resulted from the judicious choice and laudable exertions of those gentlemen. No greater improvement, perhaps, has been made in the breed of any other stock of that country than in the pig-stock, as every one must have observed who recollects the big-boned, coarse, unthrifty animals, exported from thence about forty years ago, and has compared them with those brought over at the present time. Though I believe the general breed of that country, as well as our own, might be greatly improved by crossing with a Chinese or Neapolitan boar.

CHAP. XXVI.

BREEDING CONTINUED—AND ON WOOL.

I HAVE stated in the preceding pages, that the chest, either of sheep or neat cattle, is always in uniformity with the breast and bosom. If the breast be wide and projects forward, the chest and back will be proportionably wide also; and the animal will fatten level, from the ear to the end of the rump. A short breast may be accompanied by a large rump, but where these two points are predominant we seldom find a level fat back. A deep breast indicates a deep chest; while a short narrow breast generally marks an unthrifty animal, and is always accompanied with a large belly and a narrow crooked back. If the breast and chest be deep, the animal may accumulate fat and tallow internally, but the fat externally will be less; and to improve any of the ordinary breeds the breast and bosom are the great objects to which the care and attention of the breeder should first be directed.

To illustrate this position, I need only draw the attention of the breeder to the long-woolled pasture sheep, and call to his recollection, what they were before the introduction of the Dishley breed; and not-

withstanding the great prejudice that for such a length of time existed against them, there are few flocks now in the midland counties, but what are pure Leicesters, or a mixture of that breed.

The improved downs are now fast making their way over the hilly and thin-soiled parts of the country, but the bulk of them are ill-formed animals; and like the heath and mountain stock, are capable of great improvement in form, and lack, in consequence, the requisite aptitudes to fatten.

If we compare the unimproved down, mountain, heath, and moor-stock, with the improved breeds, we shall find that the former are by far the most numerous, and that they still remain almost in a state of nature, both in wool and carcass; and when we reflect on the fact, that such an immense sum goes annually from this country to purchase fine wool, one cannot help regretting that little or no exertion has hitherto been made to improve the numerous breeds of our small native sheep. In these enlightened days, where perseverance, in so many instances, has been followed by success, and when knowledge, the genuine offspring of experience, in almost all rural affairs, has been progressive, one scarcely knows to what cause this state of things is to be attributed; whether to those individuals who have had the best opportunities of trying the experiment and have neglected to do so, or to the want of legislative enactments.

During the time there was a high duty on fine foreign wool, a great number of fine woolled shee

were imported into England from Spain and other countries on the Continent, with a view to raise wool of a finer staple ; but the animals were so ill-shapen, that even with the high value of their fleece, it was soon found they could not be put in competition for profit, with our native breeds. They were too unthrifty for the best land, and too weak in constitution for the heaths and mountains ; and if fine wool is to be raised in this country, it is clear that the first object attempted must be to improve the carcass.

In every distinct character of the sheep, we generally find the finest staple of wool on the best animals. The unimproved Downs, the Woodland Scots, the Welsh mountain, the heath, and the moor-stock, like the Spanish, are all narrow and short in the breast, consequently they have narrow crooked backs, and are unthrifty ; and they can only be improved by the means I have recommended ; as I think it is much more probable that fine wool can be raised on a good-formed sheep, than on an ill-shaped one.

Soil and climate, it has been said, have a great effect on wool ; but in England, we find coarser and finer fleeces on every variety of character ; and one great obstacle to the growth of finer wool in this country, is the want of protection against foreign imports.

Spain excels all other countries in wool, in consequence of the stimulus she receives by always finding a high price for it in England. By improving the carcass of our small breeds of sheep, we should not only be laying the foundation for raising fine wool,

but we should add to the shambles, and diffuse this delicate mutton more plentifully throughout the country; and perhaps obtain them as fat from their native pastures, as they now are, after they have been depastured in a nobleman's park, or on some other rich land for six months.

In illustration of some of the above, as well as other remarks which I have previously made, I cannot, I think, do better to impress them more strongly on the mind of the reader, than lay before them a brief description of the farm and stock at Whitley Abbey, the seat of the late Lord Viscount Hood. His Lordship, I should premise, was not only a zealous patron of Agriculture, but was also an able practical agriculturist, and personally and economically directed and superintended many valuable improvements that have been made upon his estate. His Lordship's farm consisted of 245 acres of land; he kept about 45 acres under the plough, which he cultivated, as all arable land should be cultivated, half in corn, and half in growing vegetables, as food for cattle and sheep. His Lordship's sheep-stock at that time, (Nov. 12, 1830,) amounted to 647, fifty head of neat cattle, and five draught horses; and to say nothing of the hay that was consumed by his coach and saddle horses, the food that kept the plough-horses and cattle was equal to the maintenance of 340 sheep. At that time, his Lordship's sheep-stock was lower on the average, than it was at any other season of the year; so that his farm might be fairly estimated to carry more than 1000

sheep, a much greater number than any other agriculturist in the county, that I know of, kept upon the same number of acres. His Lordship's land, I allow, was very good, but it had been brought into that excellent condition, by the great number of sheep that had been kept upon it.

About 40 years ago, when his Lordship first came into possession of the estate, this farm had been much impoverished by growing successive crops of hay; but by the judicious management of his Lordship, the farm has, in a great measure, been greatly improved. His Lordship was his own engineer, and superintended the land, which he effectually and economically underdrained.

In a position which I laid down in a former part of this work, namely, that land would be improved by breaking up the hearth or sub-soil, I am proud to find that I am borne out by the practice that has been adopted on the Whitley Farm. His late Lordship long used a *cultivator* with two tines, to follow the plough, which loosened the earth six inches deeper than that instrument, and found that vegetation was very much promoted by the process. And I should here remark, that if vegetation be so greatly assisted by these means, on this light absorbent soil, how much greater might be the benefits which the crops would receive if a similar system were followed on the tenacious cold-bottomed lands?

Before I quit this interesting subject, I should inform the reader, that his Lordship's cattle were of the

Alderney breed ; and his sheep, the pure Southdowns, descended from the celebrated flock of Mr. Ellman, of Glynn, near Lewes ; and though his late Lordship's farm might have been capable of carrying more stock than any other of a given size, part of the credit should be attributed to the excellent constitution of his flock.

Neither should I here omit to notice, that although the *tod-bill* from the South Downs is much lighter than from the long-woolled pasture sheep, there is in consequence, more vegetable matter converted into mutton. And though the fleece from this stock, at present prices may not average quite so much as the fleece from the pasture sheep, yet their fleeces ought to be, and would be of more value, if wool of that staple were duly protected.—Mr. Ellman has latterly (November 12th, 1830,) sold his wool at 1s. 6d. per lb. when the top price for pasture wool, at the same time, was about 10½d.

CHAP. XXVII.

ON THE DISEASES IN CATTLE.

THE diseases that prove more calamitous and fatal to farming-stock than any other, are the *Rot* in sheep, the *Glanders* in horses, the *Murrain* in cattle, and the *Measles* in swine.

The rot in sheep, is a consumptive disease, and to attempt to restore the animal to health, after the malady has fixed itself on the constitution, is, I believe, a fruitless effort; and the most I can do, in this case, is to describe the cause of the disease, and then to point out a preventive. The three latter are epidemical, and may be prevented from extending themselves through the stable or herd, by using proper precautions.

The rot in sheep, is caused by unwholesome food being taken into the stomach, which coagulates there and in a short time affects the whole system. From the blood having become impure, ulcers are produced in the lungs and veins, and these engender animalculæ, which generally fix themselves at the orifices of the gall ducts, beneath the lobes of the liver, and they either prove fatal to the animal or reduce it to a skeleton. As this disease is caused either by unwholesome

food, or stagnant water, it may often be prevented by underdraining. This deleterious food, is sometimes taken up by sheep from flooded meadows, or low grounds, where the water has flowed over, and a portion of it has been left in the hollows or long declivities, until it has been exhaled by the sun and the atmosphere. It is not safe to turn sheep on this sort of land until the flooding has been succeeded by a sharp frost or an interval of dry weather. Sheep intended for early slaughter, are sometimes turned upon these meadows, in small numbers, to try if the food will communicate the rot; but these trials should not be depended upon, as small lots will graze on the banks or on the sound land, and a larger flock, when turned in after them, are driven to feed on the low ground or sides of the trenches, and often take the rot when the trial sheep escape.

Sheep should always be inured to salt when they are young, and which would, if given to them in wet seasons, and at other times occasionally, avert many diseases; it would prevent the rot, the scour, the dropsy or water at the heart, &c.

Quick-lime has sometimes been used as a *preventive* of the halt. In this case, the lime should be thinly spread on a dry floor in some building, and the flock driven over it twice a week, a little fresh lime being added each time. When sheep are depastured on land liable to occasion the halt, the safest and most effectual method to prevent the flock becoming affected, is to frequently examine their feet, and take off any excres-

cence or hollow part of the hoof, and apply a solution of spirits of turpentine, vinegar, and alum, of equal quantities by weight. This compound hardens the foot and prevents the disease.

As the other three diseases are epidemical and the dreadful calamity will communicate itself from one animal to another, until it pass through the whole herd, or stable, the first thing to be done after the disease is perceived to have seized any of the stock, is to separate those which have taken the infection from those which continue in health, and then fumigate every place in which the cattle, whether well or ill, remain, or have had access. Many fumigations have been recommended to arrest the progress, or as a preventive against the contagion of fevers, and other epidemical diseases, in cattle; but there is none within my knowledge, so salutary and efficacious as burning bones, or horn shavings, or perhaps both. The application of this fumigation is very simple; and is effected by taking a chaffing-dish of hot embers or charcoal, and burning the bones and shavings in the stable or buildings where the cattle are confined. The fume, like the disease, is taken into the lungs by inspiration, and this is often a more effectual remedy than medicine.

The *mange* in horses, and the *scab* in sheep, are taken into the system by absorption, and it may be prevented from extending itself through a stable or flock, by dressing them with mercurial ointment. This loathsome disease is neither taken nor communicated if the animals be dressed once a month. Of the many

recipes for the cure of the mange and the scab, I believe the following to be the cheapest and the best:— Take ten gallons of water from the gas-manufactory, 2 lbs. of tobacco, 1 lb. of hellebore root pulverized; boil them together till they are reduced nearly to nine gallons; then add, after boiling, a-pint of spirits of turpentine, and 4 lbs. of salt. This is a safe and certain cure, if applied to all the affected parts.

The *halt* in sheep, is another dreadful disease, that often reduces a flock to great misery. The malady is infectious and it is taken by absorption by treading in the footsteps of each other. In this as well as in other contagious diseases, the sound sheep should be separated from those that are infected, or lame; then with proper knives, their hoofs should be carefully pared down, observing not to use the same knives in operating upon the sound sheep, as you have previously used in paring the feet of those that have taken the halt. All the superfluous hoof should be cautiously taken off as near to the quick as can be done without drawing blood, as the cutting too deep would not only increase the sore, but the bleeding would prevent the dressing from taking the desired effect.

This complaint often assumes the appearance of two separate diseases, and then it may be properly termed the *halt* and the *foot-rot*, and require two kinds of dressings. They are both attended with inflammation, and demand the application of cooling astringents. Pure caustics are often used, but from being too powerful they frequently torture the animal and increase the

wound. The best liquid dressing for the *halt* that I know of, is an equal mixture (in weight,) of aquafortis, spirits of turpentine, spirits of wine and egyptiacum. This compound is to be carefully applied with a probe to the bottom or seat of the wound, if any fungus appears, a little red precipitate or butter of antimony, should be applied.

The *foot-rot* is often attended with swelling as well as inflammation. If the foot be much swelled and the pain very intense, an oatmeal or linseed poultice should be applied for a short time to assuage the pain; but it should not be continued too long, or it will encourage too great a discharge. The application for the cure of this disorder is—an equal quantity of honey and verdigris, and about one-sixth each of the above weight of alum and vinegar, all simmered together in an earthen pot, on some embers, till the ointment becomes red, and then it is to be applied to the sore on a pledget of tow. If any fungus appear, a little blue vitriol powdered fine should be added to that part of the plaister that covers the fungus.— This ointment is also a cure for the *foul* in cattle, and the *canker* in horses' heels. A tent made of this ointment, with the end dipped in, or sprinkled with a little powdered vitriol or red precipitate, if applied as above, will cure *quitters*, and generally at one dressing; but when diseases of this kind have been long standing, and have insinuated themselves into the system, the animal requires bleeding and cooling medicine, to prevent the disease from flying to the internal parts.

The *farcy* in horses, is another dreadful disease that often proves fatal. It is also contagious, and is taken by inspiration in the same manner as the *glanders*. I have good reason to believe, that the above fumigation will not only stop the contagion of the *farcy*, but with other medicines, will effect a cure.

The *glanders* is a disgusting and distressing disease, that is apt immediately to follow the *farcy*; but this will be prevented by the timely use of the above fumigation. Should this application, on further experience, prove equally as salutary in preventing the contagion in the house as in the stable, a valuable and important discovery will be the result. I have had an opportunity of witnessing the good effects of this fumigation as a preventive of disease, both in the house and stable. This effluvia will rather assist than retard a cure, and its virtues are well known to Chemists.

CHAP. XXVIII.

ON SOILS—LIGHT LAN

THOUGH wheat may be grown on light soils with success twice in eight years, I wish the reader to understand that I do not recommend that practice. Wheat should not be sown on this description of soils, oftener than once within that period ; for if the crop be taken after peas, or clover, the fourth year the cultivator is not so certain of his profit as when he takes brush turnips after barley ; and that three crops of barley and one of wheat, between the green crops, is less exhausting to the soil, as well as more to be depended upon in returning a profit to the farmer.

One of the great advantages to be derived from applying dung to the growth of green crops, and more particularly to vetches or early peas, is by the manure becoming well-mixed with the soil, the turnip crop is more rapidly thrown into the rough-leaf, and by that means, the danger of its being taken by the fly, is considerably diminished. On the other hand, I should not

omit to remark, that there is more danger of the turnips being injured by the slug after vetches, than after what may be called the less-smothering crops ; but sowing a little quick lime over them, in the manner I have before directed, will prevent the slug from doing much mischief. Lime, in a carbonated state, is ever a useful ingredient in all soils, and when we consider the value of the turnips, as food for the stock, and the improvement they make in the soil, and then allow for the difference, between what is taken out of a light soil by a crop of wheat and a crop of barley, we shall find the latter system to be by far the most economical.

ON HEAVY SOILS.

Wheat should be grown twice in eight years upon all heavy soils. That is, the first year after clover, and the fourth year after beans, clover, or vetches, according to the fertility of the soil. Cabbage, or beans, take more out of the soil than vetches or clover. When land is in its highest state of fertility, and will grow profitable crops of cabbage or beans between the corn crops, the prudent farmer will take care to keep it so. Vetches should never be omitted the sixth crop, for this is what may be termed the *fallow-crop*, to free the land of all noxious seeds and weeds, as well as to meliorate the soil, and prepare it for barley and clover, which is laying the foundation for the other succeeding crops.

To these rules which I have laid down for the cultivation both of light and heavy soils, there is no

variation within my knowledge, that can be usefully made, excepting it be to substitute oats for barley in those situations or climates only, where there is a risk in growing a crop of barley. That is, on those lands where the sub-soil is damp or impermeable in the heavy, or on the light, on the friable, heathy, or boggy soils. In the former case, where it is the usual custom to sow oats immediately after wheat, barley may often be grown after a crop of vetches, with a much greater profit. The oat is a hardier plant than barley, and perhaps the tartarum, or black oat, is the most proper for high or bleak situations, or on the damper soils.

There is no obstacle, in my opinion, at least no one has yet presented itself to my mind, to prevent a rule from being laid down suitable to each description of soil. This would at once advance the Art of Agriculture into a Science, and would be a most important stride taken on the road to perfection. Chemistry, and all the other sciences, have passed a similar ordeal. If the land were to be cultivated upon any one defined system, making every reasonable allowance for all the variations of soil, situation, climate, aspect, and condition, men of talent and zeal would congregate to compare the success of their respective experiments, and the result of those experiments would, and at no remote period, I trust, ultimately tend to establish a system of agriculture upon those firm and scientific principles, that would soon prove to be highly conducive to the interests of the whole community.

I do not see any reason myself why a rule should not be laid down for the cultivation of a farm, as well as for the conducting of any other art. Regularity is as essential in farming, if not more so, than in the management of many other branches of business; and if disappointments occur to the farmer in consequence of the vicissitudes of the season, I have before pointed out to him how he may proceed without affecting the course of cropping.

I have, in a former part of this work, mentioned a field that had grown wheat and beans alternate, for the last twenty years. This is a system easy and practicable with the use of the hoe and fork, but a continuance of such exhausting crops will require some foreign manure to keep up the fertility of the farm, even on the best soils.

CHAP. XXIX.

ESTIMATE OF VALUE, AND EXPENSES OF CULTIVATING
THE VETCH, COMMON TURNIP, SWEDE TURNIP,
CABBAGE, CARROTS AND PARSNIPS, MANGEL-
WURZEL, POTATO AND LUCERN CROPS — COM-
PARATIVE VALUE OF CROPS BY THEIR NUTRI-
TIVE QUALITIES—ON LUCERN, WITH ESTIMATE
OF RAISING A FIRST CROP—ON CLOVER, &c.—
ON THE TARE—ON RED CLOVER—ON SAINFOIN—
COMPARISON OF CROPS.

I CAN find no analysis that shows the proportional part of nutritive matter in vetches; but in Mr. Mure's experiments on roots and different vegetables, I find that cattle gained more weight in a given time while feeding on vetches, than they did when feeding on clover, natural grass, cabbages, or raw potatoes.

The culture of vetches is very simple and cheap when compared with the trouble and expense that it takes to raise many other crops; and as the land is always left in a better condition for a succeeding crop after the vetches are eaten off, than it was before they were sown, there is no charge for manure for the growth of the crop. In estimating the value of this crop to eat green on the land, and considering it to be calculated for all kinds of soil, I compute it to be equal to one of common turnips.

Vetches should always succeed a corn crop. I shall lay the forking, ploughing, harrowing, and seeding, at 34s. per acre, mowing, the crop, &c., for the stock, 5s. per acre. This sum, in the general way of soiling, may be thought rather too small; but when vetches are consumed by horses in the stable, or sheep in the field, there is no more labour employed than what they would otherwise require, and this sum may be quite adequate to wear and tear of hurdles and other implements.—The estimate of the crop, and expenses of cultivation will then stand thus:—

	£.	s.	d.
Value of crop,	5	0	0
Rent and Taxes,	1	10	0
Forking, tillage, and seed,	1	19	0
Dung or carting,	0	0	0
Profit,	1	11	0
	<u>£5</u>	<u>0</u>	<u>0</u>

The Common Turnip is generally planted on the high dry-bottomed soils; which grow from 10 to 30 tons per acre; 20 tons, perhaps, may be above the average produce per acre taking all seasons. The estimate will stand as under:—

	£.	s.	d.
Rent and Taxes,	1	10	0
Tillage, equal to five ploughings,	3	0	0
Seed, drilling, hoeing, hurdles, &c. &c.,	0	15	0
	<u>£5</u>	<u>5</u>	<u>0</u>

	£.	s.	d.
Twenty tons, at 5s. per ton,	5	0	0
Loss,	0	5	0
	<hr/>		
	£5	5	0
	<hr/>		

Swede Turnips are grown both on heavy and light loams, and taking an average of crops and seasons grow a greater weight per acre than the common turnip; but it is said they do not leave the land in so good a condition for succeeding crops as the former.—The estimate will be as follows:—

	£.	s.	d.
Twenty tons, at 7s. 7 $\frac{1}{4}$ d. per ton,.....	7	12	1
<hr/>			
<i>(See table, page 253)</i>			
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Rent and Taxes,	1	10	0
Tillage, &c., as above,	3	15	0
Extra for dung,	1	0	0
Profit,	1	7	1
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	£7	12	1

Cabbages may be grown on almost all kinds of soils. The large Drum-top, or Scotch, when planted early and on good deep land, grow to a greater weight per acre than turnips, and may be estimated higher; but the York, or quicker growing sorts, are sometimes planted as late as June or the beginning of July, and though they may be planted thicker than the larger sorts, it cannot be expected that they will grow to an equal weight per acre, but perhaps I am estimating this crop too low when compared with turnips. Taking

them at twenty tons per acre, and they may be rated much higher, say from fifteen to thirty-five tons, and they will stand thus:—

	£.	s.	d.
Twenty tons, at 8s. $8\frac{1}{4}$ d. per ton,	8	13	9
<hr/>			
Rent and taxes,	1	10	0
Tillage, equal to four ploughings,	2	8	0
Rearing plants and planting,	0	6	6
Ploughing between the rows, hoeing, &c. 1	0	0	0
Cutting and carting,	0	10	6
Dung extra,	1	10	0
Profit,	1	8	9
	<hr/>		
	£8	13	9
	<hr/>		

Carrots and *Parsnips* affect a deep sandy soil, or a rich deep dry-bottomed loam. Mr. Young, in his *Annals of Agriculture*, (written some years ago,) strongly recommends the cultivation of these crops as spring food for all kinds of stock, particularly for horses. He states that 400 bushels or ten tons per acre, is an average crop on the best land. At the time he wrote, the value of Swede turnips was but partially known, which have become applicable to the same purposes, and may be grown on various soils that do not suit the former plants; and what is still of more importance, they are sown at a season which gives greater advantages to the planter in cleaning and pulverizing the soil. These two last objects alone, are sufficient to give a decided superiority to the latter over

the former, even if they were equally valuable in other respects. By estimation they stand as under :—

	£.	s.	d.
Value of crop,	5	16	8
Loss,	0	7	0
	<hr/>		
	£6	3	8
	<hr/>		
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Rent and Taxes,	1	10	0
Deep autumn ploughing and spring tillage	2	6	0
Seed and drilling,	0	6	6
Four hoeings and hand weedings,	1	2	6
Forking up, topping, carting and housing,			
4s. 8d. each,	0	18	8
Dung,	0	0	0
	<hr/>		
	£6	3	8
	<hr/>		

Beet, (mangel wurzel,) is generally planted on ridges, and affects all turnip soils, heavy loams, or clayey loams, where they can be pulverized sufficiently early. It is cultivated in a similar manner to cabbage, and like them requires early planting to bring it to the greatest perfection. The plants are more certain of escaping the fly, and less liable to mildew than turnips, and if planted on ridges, on a well-pulverized soil, with plenty of manure, are seldom affected with excess of drought, or wet. In fact, I do not know of any bulbous rooted plant, excepting potatoes, that is so easy to raise, if properly managed, as the wurzel. The husk of this seed, if not bruised or broken before it is sown, will prevent some of the seeds from growing.

I have often observed, and others who have been in the habit of growing this plant must have done the same, that fresh plants, after every shower, will keep springing up all through the summer. Those seeds by being locked up as it were in the husk, with the soil adhering to it, had rendered them impermeable to air. The husk, before sowing, should have been carefully broken, (as before observed,) without bruising the seed; and if too dry, should have been steeped for twenty-four hours, but not dried afterwards. No seed after being steeped should be dried in the sun; if it require drying it should be exposed to the air when it is fullest of oxygen. The seed should be dibbled into the cool soil, and if it be moist, the shallower it is planted the better. The crop and expenses as follow:—

	£.	s.	d.
Value of crop, 15 tons, at 17s. 7d $\frac{1}{4}$.			
per ton,	13	4	0 $\frac{1}{4}$
<hr/>			
Rent and taxes,.....	1	10	0
Tillage,	2	8	0
Seed and planting,	0	6	6
Ploughing between the rows, and hand hoeing,	1	0	0
Forking up, topping, carting and housing,	0	15	0
Extra for dung,.....	1	10	0
Profit,.....	5	14	6 $\frac{1}{4}$
	<hr/>		
	£13	4	0 $\frac{1}{4}$
	<hr/>		

Potatoes affect a deep sandy or dry loamy soil. They are said to be a good preparative for wheat; but on this kind of soils they often leave the land too light and loose for that plant, and should be grown as a barley-fallow crop. In this case the tillage in the spring gives to the farmer an opportunity of picking any small bulbs that may have been left in the ground, and escaped the winter's frost; which, in some seasons are injurious to the wheat crop. Mr. Young, in his experiments with different manures on the same land, has stated the produce with stable dung as high as 660 bushels per acre; but I conceive that this produce must have been taken at 56lbs. per bushel; 480 bushels would then make 12 tons; or 336 bushels reckoning 80lbs. to the bushel; this must be considered as a great crop; one of the most productive kind from the best land. It will be seen below that this nutritious crop affords a net profit of £6. 10s. 1¼d. per acre, at some trifle less than 18d. per hundred weight. My motive here is to draw the attention of cultivators to this most nutritious crop. There can be no doubt that potatoes are a greater exhauster of the soil than any other seedless crop, and perhaps quite as much so as a corn crop; and where the crop goes wholly off the farm, it would probably require an expenditure of £4. per acre in manure, to restore the land to its former fertility. In the following estimate, I have made an allowance of £2. per acre, in order to bring the cultivation of this crop to a fair comparison with the other seedless crops, but the whole of the vege-

table crops must be considered as meliorating when they are consumed on the farm. The following estimate is calculated at 12 tons per acre :—

	£.	s.	d.
Value of crop, 12 tons, at 29s. 9½d.			
per ton,	17	17	6
<hr/>			
Rent and Taxes,	1	10	0
Tillage, equal to three ploughings,	2	8	0
Seed and planting,	1	10	0
Horse and hand hoeing,	1	5	6
Digging up, &c. 480 bushels, at 1d. per bushel,	2	0	0
Dung,	2	10	0
Profit,	6	14	0
	£17	17	6

Lucern is partial to a deep dry good loam. The land is generally prepared as a fallow, and the seed, which is planted alone, takes two years to root and establish itself in the soil, before it comes to perfection, and is ready for cutting. Of this plant I have made three separate estimates : one of the expenses of raising the plantation, another of its annual expenses and the value of the produce, and the third valued at a full crop ; see page 350.

This crop has been most commonly planted in drills ; but I have on another occasion said, that it is

most productive, and is kept freer from grass and weeds when sown broad-cast.

Profits and Losses brought forward.

	<i>Loss per Acre.</i>			<i>Profit per Acre.</i>		
	£.	s.	d.	£.	s.	d.
Common turnip,.....	0	5	0	....		
Swede ditto, .....				....	1	7 1
Cabbage, .....				....	1	8 9
Carrots or parsnips,	0	7	0	....		
Mangel-wurzel, .....				....	5	14 6 $\frac{1}{4}$
Potatoes,.....				....	6	10 1 $\frac{3}{4}$

In comparing the value of these crops by their soluble and nutritive properties, we find that they vary much ; but the difference must not be regarded as denoting their value as a crop, some of them being exhausters, and others of them more or less improvers of the soil. Potatoes take from the soil the most vegetable matter and return the least, even if consumed wholly on the farm. Turnips return the most, and probably take out the least. From the highly nutritious properties of the mangel-wurzel, it appears the most profitable crop for feeding cattle. Cabbage, for the same purpose, seems to stand next, with the exception of (cooked) potatoes. Swede and common turnips appear to claim the preference for feeding sheep. Parsnips and carrots, although they possess a high comparative nutriment, yet their produce is so small that the expenses of rearing the crop seem to exclude them from being brought into competition with the other roots, as food for stock.

To those who grow Lucern as food for cattle, such an implement as I have before described for cleaning the crop, will be indispensable. If the seed be sown broad cast, I see no reason why it should not be raised with the barley crop, in the same manner as we do clover. Or, spring wheat, or oats, perhaps would be less liable, if sown late and not too thick, to fall and injure the young plants. There is one advantage in cultivating this crop, that is not common to any other of its species, for if the seeding fail of producing a full crop of plants, more seed may be worked into the ground by the instrument above alluded to, and thus the crop may be continued longer in the ground on the broad-cast, than on the drill system. The broad-cast crops are more readily mown than those sown by the drill, and the ground is raked with greater facility, and the rakings are got up freer from dirt.

Under the management here described, I should think a crop of this plant would continue on the ground for twenty years, if sufficiently manured and kept free of grass and weeds, it then might be cut three times or more during the season, and taking each cutting at ten tons per acre, and comparing its nutritive properties with clover and sainfoin, at 5*s.* per ton, it would leave a net profit of £2. 3*s.* 7*d.* per acre, per annum. But lucern is recommended by some other good properties, that should not be omitted. This crop is ready to cut earlier for soiling than clover or any other vegetable; and as the tap-root strikes deeper into the

ground than many other plants, it is enabled to endure the extremes of heat and wet much better than any of them. Lucern does not exhaust the soil so much as some other crops, and it also returns more manure to the land, but this I have taken into consideration in the following estimate, where I have only charged for carting the manure from its own produce back to the ground; and I should also notice, that I have not made any charge for rent or manure, for the first year. In the first instance, I have assumed, as the lucern was raised with a crop of spring corn, that the rent should be placed to the grain crop; and in the second place, on the assumption of the land having before gone under a regular course of green and white straw crops, and brought into a high state of cultivation, clean and full of vegetable matter.

I wish to caution those farmers who have not had any experience in growing lucern, not to attempt to raise a plantation on land that is not naturally dry and permeable in the sub-soil, as well as on the surface; nor to plant it in old gardens or in shaded orchards, until they have been well cultivated, and they have got rid of all seeds and weeds; for in either of these cases, in nine instances out of ten, he must expect to be disappointed in his crop. In those parts of the country where lucern is cultivated to any extent, the rule is to plant it on the very best land on the farm; and we hear that such land has returned the astonishing produce of five cuttings in the season, of forty tons or more, from an acre, on the whole year's produce.

Mr. Young, in his *Annals of Agriculture*, says—
 “In the application of this crop the principal and obviously the most advantageous practice is that of soiling horses, neat cattle and hogs. But as a dry fodder in many instances, it is also capable of affording much assistance. And as an early food for ewes and lambs, in particular cases, it may be of great value. As this plant bears repeated cutting better than most of those of the artificial grass kind, springs in a more quick and expeditious manner, and affords a healthy nutritious food for soiling, it must be of vast utility to the farmer where horses and cattle form a large part of his stock. With horses, in this way, it has been found by some to answer better than any other sort of green food that has been tried. The number of cuttings that it admits of, being on different soils and under different modes of culture, from about three to five, affording a produce of green herbage adequate to the support of from three, to four or five horses per acre for a period of nearly six months in the summer season. And though much of this vast advantage, in the support of these animals, may with propriety be ascribed to the economy of the consumption of the food that unavoidably takes place in this excellent practice, the real produce in green food is without doubt larger than in most other grass crops.” But at the time Mr. Young wrote his *Annals*, the nutritious properties of lucern were not known, nor had they been compared with other succulent plants; and although it possesses all the excellencies which I have before ascribed to it,

still it bears no comparison with either clover or vetches, in point of tillage economy, or nutritious qualities.

The broad-cast crops, in the trials of some cultivators, appear to have been more profitable in this mode of consuming the produce, than those of either the drilled or transplanted methods of culture. In the practice of Mr. Hall, the former supported from four to five horses for twenty-six weeks, while the crops transplanted in rows, two feet asunder, only afforded produce sufficient for the keeping of three. And in that of Mr. Clayton, in the broad-cast without grain, five horses were kept from the middle of May, till Michaelmas, while that drilled in equi-distant rows of eighteen inches, only supported four."

There are many other facts that lead to the same conclusion. Mr. Pratt, from his three acres, in the summer of 1830, wholly supported ten horses and a bull from the beginning of May till the 14th of June, besides what was eaten by the horses of his friends, who visited him at that season of the year, for the purpose of inspecting and hiring from his noted stock of rams. Those friends are often very numerous, and their horses must have consumed a great deal of the food. His first cut must have been upwards of ten tons to the acre; and Mr. Pratt intended to cut it twice, if not three times more in the summer; but this was the best crop of lucern I ever saw growing.

*An Estimate of Five Tons per Acre, raising the
Plantation the first year with Grain:—*

SECOND YEAR.

	£.	s.	d.
Value of crop, 15 tons, at 5s. per ton, ..	3	15	0
Loss,	0	7	9
	<hr/>		
	£4	2	9

Scuffling, harrowing, and picking, in			
Autumn and Spring,	1	5	0
Twice mowing and carting the crop,	0	10	0
Carting and spreading manure,	0	15	0
Rent and Taxes,	1	10	0
Ditto, addition on first year's loss,	0	2	9
	<hr/>		
	£4	2	9

Value of crop, 5 tons, at 5s. per ton, ..	1	5	0
Loss,	2	15	0
	<hr/>		
	£4	0	0

Seed, 20lbs. and sowing,	1	10	0
Scarrifying, harrowing, and picking pelf,			
in Autumn and Spring, 12s. 6d. each	1	5	0
Mowing, raking, and carting,	0	10	0
Carting and spreading manure,	0	15	0
	<hr/>		
	£4	0	0

THIRD YEAR.

Value of crop, 30 tons, at 5s. per ton, ..	7	10	0
Twice scuffling, harrowing, picking, &c.,	1	5	0
Three times mowed,	0	15	0
Carting and spreading manure,	0	15	0
Rent, &c., as above,	1	12	9
Addition on last year's loss,	0	0	4½
Profit,	3	1	10½
	<hr/>		
	£7	10	0

Mr. Young says—"Lucern, in its application in the soiling of cows and other sorts of cattle, in the fold-yards, and in the feeding and fattening of oxen, its importance is very great. It is found that in soiling cows, the proportion of this sort of food, consumed in twenty-four hours, is from about sixty or seventy to upwards of one-hundred pounds, in those which are of the middling-sized kinds, an acre maintaining in the proportion of about four for twenty weeks. In other trials larger proportions of stock have been kept by this practice."

In the trial of four cows for twenty-one weeks, they consumed one-hundred pounds each in twenty-four hours. The produce of an acre would be twenty-five tons, but in some of the former trials it would be from about thirty, to forty or fifty tons. Those who have grown this crop on their rich soils, may think that I rather under rate the weight at thirty tons per acre; but I should observe that it is merely taken comparatively with other crops, as I have no desire to under value the crop to mislead the inexperienced. No one can doubt, however, that soiling is the most economical way of keeping stock.

The same author gives us an experiment between soiling and grazing of clover. He says, in the trial of seven acres of clover cut green, they were found to be sufficient for twenty horses, seven cows, five calves, and five pigs, for a period of seventeen weeks, from the middle of May. They were fed in the stable and rick-yard, being taken twice in the day to water, and

the horses had neither hay nor corn. The great superiority and utility of this practice, is exhibited in a more striking point of view, by contrasting it with the consumption of the same sort of crop in the field, by an equal number of the same stock ; as in the time that five acres had been used in the former method, thirty had been consumed by the latter, and the horse stock was left in a much worse condition.

The great difference between feeding clovers off the land, and consuming them in their green state, in the manner just mentioned, is supported by an able writer, (Mr. Kent,) to be as follows :—“ The quick growth of this grass, after mowing, shades the ground, and prevents the sun from exhaling the moisture of the land so much as it would if fed bare, consequently it continues to spring with more vigour, and the moment one crop is off, another begins to shoot up. Whereas when cattle feed on it, they destroy almost as much as they eat ; and besides, bruise the necks of the roots with their feet, which prevents the clover from springing so freely as it does after being clean cut up by the sithe. In the hot weather, which is the common season for feeding clover, the flies too are generally so troublesome to the cattle, that they are continually running from hedge to hedge, to brush them off, by which it is inconceivable what injury they do to the crop. But when they are fed in stables or yards, they are more in the shade, they thrive better, and at the same time consume the whole of what is given to them without waste. The chief drawback upon the advan-

tages derived from this almost invaluable plant, is that it continues so short a time in the land, especially in those of the lighter and freer kinds. An assertion has been made by Mr. Kent, that clover will not last more than two years, except on land that is perfectly fresh, and in some cases, where it has been often repeated, not more than one. In some of the southern districts, however on the calcareous soils, and more particularly where it has not been frequently repeated on the same land, it is found to be more durable.

Mr. Young says—"It is evident, from what has been said on this plant, that it must be of vast advantage to have a sufficient extent of it where much stock is to be kept, as it has been found, as pasture, to far exceed most sorts of natural grass in the support of animals.

When the clovers are kept in this state for more than one year, they are not by any means so proper for sowing wheat after as in other cases; it is the full smothering crops that afford the most suitable preparation for this sort of grain."—*Synopsis of Husbandry*.

TARES.—This is a plant, (says Dr. Dickson, in his *Practical Agriculture*,) which, from its tall, close, hardy growth and succulent nature, is capable of being introduced with vast advantage in the manner of those of the artificial grass kind, between different sorts of grain crops, with the view of preventing the fertility of the land from being too much expended, and at the same time procures a useful supply of green or other fodder

for the consumption of horses, or other description of stock. It has indeed been contended by an intelligent cultivator (Mr. Young,) that it “may be the means of enabling the arable farmer to support as much live stock as the grazier; as while crops of this sort remain upon the ground, they afford larger supplies of the best kind of green food on the acre, than the most rich and fertile grass lands; and they may be taken from the ground at so early a period in the summer season, as on the friable loamy soils, to admit of a clean crop of turnips being obtained from the same land in the same year, and of those of the heavy kinds being sown with wheat.”

And (Dr. Dickson again says,) “while they are capable of being raised with success on most kinds of soils and situations, they support and fatten cattle and sheep of different sizes and different breeds, in an expeditious manner. Besides, they afford a preparation for other sorts of green crops, and in that way keep up the succession of such kinds of food for the fattening of additional quantities of animals; and in that way produce abundance of manure in situations where it could not otherwise be procured. In short, he supposes that by a judicious combination of this plant with those of turnips, clover, and sainfoin, the poor downs, sheep-walks, and other waste lands, may be rendered from ten to thirty times more valuable than they are at present.”

An intelligent agriculturist, (in the *Middlesex Reports*,) is of opinion, “that the farmer’s stock should

be wholly supported on the tare crop from the time they begin to blow till the blossoms begin to drop off, and the formation of pods takes place. On account of the risk from wet, he recommends that all the stock of a farm should be soiled on them green, as it will have the good effect of taking it off the grass land long enough to allow of its being mown for hay ; and by this means the meadow hay will be much increased in quantity, and there will not be so much occasion for pasture, the tares abundantly supplying its place. Besides, at the time the cattle return from green tares, the grass land in the mean time having been mowed, may be ready to receive them."

It is further observed, (in the *Gloucestershire Reports*,)—"That as it would be wasteful in the extreme to turn live stock into a field of tares, as their treading and lying down would do great mischief to the crop even by feeding it in small patches hurdled off, the most advisable method would be to mow the tares off the first half acre, and to carry the produce into the stable, cow-houses, and fold-yards, or on to poor land to be consumed by stock ; then to hurdle the growing tares from cleared ground, into which put the stock and feed them all with the tares given to them in racks, removing the hurdles and the racks forward daily to the edge of the growing tares ; which will manure the land uniformly and deposit all the urine in the soil. Another recommends rack hurdles, which are made the same as the common five-railed ones, only leaving the middle rail out, and nailing up-

right pieces across, at proper distances, to admit the sheep to put their heads through. A swath of vetches being mown in a direction you wish to plough the land, a sufficient number of these hurdles, allowing one to five sheep, are set close to it : at noon the shepherd mows another swath and throws it to the hurdles, and the same at night : and keeps on mowing and shifting the hurdles occasionally."

However sanguine some of these observations may appear, if my limits would admit, I could quote many more equally as strong in support of the advantages connected with the cultivation of this plant.

The *Suffolk Report* says—"Tares are of such infinite importance that not one-tenth of the stock could be maintained without them ; horses, cows, sheep, hogs, all feed upon them. The last sort of animals are soiled upon them without any other food. Cows give more butter when fed with this plant than with any other food whatsoever."

In a former part of this work, I have shewn the value of the vetch, intercedent with other crops ; and in another part I have compared its nutritive properties with other vegetable substances ; and when we consider that this crop may be grown with success on almost all the varieties of soils, and is good food for all kinds of stock, too much cannot be said, to impress its great importance on the notice of the cultivator. This crop we find has been recommended for the improvement of poor soils ; and I have before noticed, when vetches are sown upon land in good condition, and free

from couch-grass, and mowed green, although taken off the land, the soil, from the shady and smothering nature of the crop, is left in a mellow and better condition for succeeding crops, than it was before that crop had been sown; and if any small weeds spring up with the crop, it has a tendency to smother them, or check them in their growth; and from the land being left light and friable, the air penetrates into the soil, and causes all noxious seeds to vegetate, which might otherwise spring up and injure future crops.

There are other advantages connected with this crop, which have not yet been touched upon, and although they are of a minor description to those which I have before enumerated, still I consider them to be of too much importance to be entirely omitted. The value of this crop is augmented in a dry summer, for if the pastures be scorched up and the ponds dried, it will in some measure supply the stock with both food and water. In harvest or at other busy times, they are easily mowed and collected, and brought home to the stock at mornings and evenings; and if the dairy cows be not regularly soiled, whether the season be dry or wet, they should always be fed with them while milking, for this will increase both the quantity and quality of the milk. In this case, to prevent disputes and jealousy amongst the boys, the cow-boy should do his part of the mowing, and the stable-boys should cart them home; and in this way they are gathered and carted, without much trouble, and at a trifling expense.

CLOVER.

	£.	s.	d.
Estimate of crop, at various mowings, 30			
tons, at 8s. 5½d. per ton,	6	15	4
Seed and sowing,	0	10	6
Mowing and soiling,	0	5	0
Rent, &c.,	1	10	0
Profit,	4	9	10
	£6	15	4

SAINFOIN.

Estimate of crop, 12 tons, at 8s. 5½d.			
per ton,	5	1	6
Seed & sowing, 4 bushels, at 5s. 4 ^p bushel	1	0	0
Mowing and soiling,	0	5	0
Cleaning and carting dung, as in lucern,	2	0	0
Rent, &c.,	1	10	0
Profit,	0	6	6
	£5	1	6

The profits after the first year will be, .. £1 6 6

BROUGHT FORWARD.

Lucern, per acre,	3	1	10
Clover, ditto,	4	9	10
Sainfoin, ditto,	1	6	6

We perceive, by these estimates, that clover much exceeds lucern in value; and sainfoin, for the purpose of soiling, or using green, bears no competition with either; but the merits of sainfoin, will be found by converting it into dry fodder, and by its affecting poorer soils. This crop is particularly useful on those

farms where there is a deficiency of meadow land ; it is made into hay at a less expense and with less risk in spoiling, than either clover or vetches, and the hay is more valuable for sheep or cattle, than either clover or vetch-hay, and it may be grown on rocky land of less value ; and then, probably, from the above produce, with the difference in rent, and the other advantages I have above enumerated, in some situations, it may approximate nearer in value to those crops with which I have compared it on their respective and peculiar merits. Sainfoin will remain in the land, eight, ten, or in some instances, fourteen years ; and would, probably, if cleaned and the soil well pulverized with the *cultivator*, and fresh seed worked into the soil occasionally, and dressed every third year with dung and six or eight bushels of gypsum per acre, continue in the land as long a time as lucern.

CHAP. XXX.

GRASS FARMS.

In the grazing districts the quantity of stock to be kept upon any given space, must naturally vary according to the fertility of the soil and the situation of the land; and no general rule can be laid down to determine what proportion of sheep to cattle should be kept to return the most profit. I have given below a quotation from Mr. Young's *Agricultural Survey of Lincolnshire*, of the various proportions of stock kept on the rich pastures in the neighbourhood of Boston; and from this it will be seen, that, on an average of twenty-five farms, districts, or fields, there are stated to be, three and three-fourths sheep to an acre; with a bullock to one acre and three-fourths with the sheep; and two sheep wintered on an acre. This summer stock is about equal to seven and a half sheep to the acre, without bullocks; or a bullock to an acre and one-sixteenth, without sheep. On the assumption that a sheep consumes or requires 16lbs. of grass per day, and an ox 128lbs. these farms, or fields, must have been of the most fertile kind, and equal to land

that would cut upwards of two tons of hay per acre, mowed in the usual season, from ten weeks' growth.

PLACES.	Sheep in summer per acre.	Acres per bullock in summer with the sheep.	Sheep in winter per acre.	RENT
Long Sutton,	5½	2½		
Mr. Scroop,	11	No Oxen.		
Boston, &c.	4	1½	2	40
Shirkbeck,	5	1¼	2	
Boston,	5	1	3½	
Deeping Fen, Mr. Graves,	5	2	1½	40
Alderchurch, Mr. Berridge	7½	2	3	
Sweens-head,	2½	2	2	
Ewerby,	3	2½	2	
Horbling, &c. ..	3	2	2	30
Howel,	3	3	2	
Immingham,	1	1½	2	
Grainthorp, &c.,	3	3	1½	
Stallenborough,	2	2	2	
Skidbrook,	1½	1½	½	
Ditto, &c.,	2	2	2	35
Addlethorp,	5	1¼	2	40
Gosberton,	6	1	0	
Burgh, &c.,	5	2	2	40
Wrangle,	2	2	0	36
Hundred of Sherbeck, ..	2	1¼	2½	45
Wibberton,	5	2	2	
Marsh Chapel,	3	2		35
Ditto,	3	1		45
Grimsby,	2¼	1	2½	
Average,	3¾	1¾	2	

It is evident, from this table, that at the time the survey was taken, the occupiers adopted no general rule in apportioning their stock; and we may suppose, even if all circumstances had been alike, no definite rule could have been adopted. Yet, at that time,

perhaps the price of wool might have had an influence with some individuals. I must here remark, that on rich fertile land, a greater proportion of sheep may be depastured with oxen, with less annoyance to their progress in fattening, than on less fertile land ; and we know that where close good sheep grazing has been long practised, the pastures become finer, than on those lands where oxen have been depastured with a smaller proportion of sheep. At the same time, no general rule can be laid down for all situations. The deep heavy loams are those best calculated for heavy cattle, and perhaps the dry light loams for sheep ; and the dry permeable bottomed land, either heavy or light, the best for wintering either cattle or sheep.

Some graziers assert that where large oxen are to be fatted, no sheep ought to be depastured with them. But the more general opinion seems to be, that a middle-sized ox, and a sheep or two, to the same space of land, may be fattened to more profit, than a large ox can be when grazed alone, and that two oxen and three sheep is a full stock for three acres of the very best land ; and probably the same number of stock to three acres and a half of the second-rate land, may be about the medium of stocking, where the stock is intended to continue on the land the whole of the summer months. There can be no doubt, however, that the fewer the sheep, the faster the oxen will thrive. The third-rate grass land, I believe, is never employed to greater advantage than by a full stock of store sheep, and a small number of young cattle.

The next thing I have in view, is to draw a comparison between arable and grass land. I have heard it asserted by practical farmers of great eminence, but not without some degree of hesitation, that the arable farmer, by adopting a good course of green crops between his corn crops, might keep nearly as much stock as the grass farmer. Now if I take 200 acres of grass land, such as I have before described, keeping two oxen and three sheep on three acres the whole of the summer months, and two sheep on an acre the six winter months, and supposing an ox to consume or require 128 lbs. per day, and a sheep 16 lbs. we shall find the consumption of grass by the oxen, to be 1560 tons, and by the sheep, 715 tons, making the whole of the food consumed, amount to 2275 tons.

I will then assume these 200 acres to be half a light and half a heavy loam, and that they are cultivated as under :

HEAVY LOAM.

A.	R.	P.		TONS.
12	2	0	Wheat,	
12	2	0	Cabbage, 30 tons per acre,	375
12	2	0	Barley or Oats,	
12	2	0	Vetches, 14 tons per acre,	175
12	2	0	Wheat,	
12	2	0	Swedes, Wurzel, or Cabbage,	250
12	2	0	Barley,	
12	2	0	Clover, 20 tons per acre,	250
<hr/>				<hr/>
100	0	0		1050
<hr/>				<hr/>

LIGHT LOAM.

A.	R.	P.		TONS.
12	2	0	Wheat—brush turnips, 5 tons, ..	62
12	2	0	Vetches and turnips, 24 ditto, ..	300
12	2	0	Barley and turnips, 5 ditto,	62 $\frac{1}{2}$
12	2	0	Swede turnips, 20 ditto,	250
12	2	0	Barley,	
12	2	0	Vetches and turnips, 24 ditto, ..	300
12	2	0	Barley,	
12	2	0	Clover, 20 ditto,	250
<hr/>				<hr/>
100	0	0		1225
<hr/>				<hr/>

By these estimates, we find the weight of herbage on the 200 acres of grass land to be 2275 tons, and the weight of vegetables on the 200 acres between the corn crops to amount to the same weight.

The fact is well known, that stock consume more or less of any food in proportion to the mucilaginous matter it contains. Half-a-hundred of hay per day, as before observed, is about the average consumption of a full-sized ox, or of a middle-sized milch cow; and from four to five pounds of dry food will be sufficient for a sheep that would require fourteen pounds or more of turnips. Now when we consider the waste that unavoidably takes place where stock is depastured, 128 lbs. may not be thought too great a quantity for what an ox consumes and spoils, in the course of a day and night. It must be admitted also, that a waste necessarily takes place in the soiling system, as well as in grazing; but, in both cases, much depends on management, and the better the land, the less, in

general, is the waste. But I should observe, the horses working the arable land, consume part of the produce.

The crops of vegetables between the corn crops may to some appear to be very great, (and they are larger than those usually grown,) but the reader should recollect that this comparison is founded on the produce of the very best of land, both grass and arable. I should likewise remark, that both kinds of land are alike liable to be affected by the variations of the seasons, and it can no more be expected that the grass land can keep so large a stock in a thriving state all through the summer, in an unfavourable season, than that the arable land can make so large a produce. Still I know, that what I have above stated, are practicable facts. To ascertain the weight of any crop while growing, is, as I have before remarked, a matter of but little difficulty. I have frequently done it myself, and have been satisfied of the correctness of the experiments, by their results. I have ascertained by similar means, the weight of a crop of hay when dry, by weighing a portion of the grass, as well as the number of bushels per acre that would be produced from a crop of corn, sufficiently correct to answer any general purposes.

I have previously stated, that vegetables lose in weight, in drying, in proportion to the quantity of mucilage they contain. Meadow grass, when in its fullest verdure, will often lose from three-fourths to four-fifths of its weight in drying; though, in dry weather, and in a more advanced stage of growth, the

same grass might not lose more than one-half or two-thirds in the same process. One pound to the yard, is 2 tons, 3 cwt. and 24 lbs. per acre; so that twelve tons of green vetches, making 40 cwt. of hay, would lose in drying, upwards of five-sixths of their original weight. Green clover, in a similar state, would lose about four-fifths; or two crops of twenty tons, would produce from 50 to 60 cwt. of hay.—The thirty tons per acre of cabbage, must weigh nearly 14 lbs. per square yard. I have often seen the large Scotch, or drum-head cabbage, weigh more than 20 lbs. each.—In a former part of this Work, I have stated that Swede turnips had been grown in the summer of 1830, the enormous weight of 23 lbs. each.

If we were to take a view of almost every district, but more particularly in the central counties of the kingdom, or where enclosures have taken place within the last century, we shall find large tracts of land in grass that formerly were in plough; and many parishes are now wholly in grass, that were principally under the plough-culture, at or subsequently to that period. In the pursuit of my inquiries into this change, I shall perhaps advance many reasons that have induced the proprietors and occupiers of land to prefer pasturage to ploughing. The cultivation of plough-land, though badly managed by some, is much better understood now than it was formerly, and great improvements have been made in it by draining. But the greatest cause of these lands having been put down into grass at that time, undoubtedly was, the

expensive and imperfect cultivation of the day. In some instances, the tithes might have been the cause of land lying in grass; but in the former case, the land was mostly exonerated of tithes, when the inclosures took place, and although it was ploughed when titheable, as soon as it was free of tithe, it was laid down in grass. At that period too, as well as at the present time, pasture land, from its appearance, gives more pleasure both to the proprietor and the occupier, than tillage, and perhaps under existing circumstances, is more certain of securing to the former, his rent. In fact, that land is not now wanted in cultivation, for any other purpose, than to find employ for our agricultural labourers. There is land enough already in cultivation, to supply with bread-corn, nearly twice the number of our population, if it were well cultivated, and I have substantively proved this most important fact, by my former estimates.

This subject has almost imperceptibly led me into a field of reflection, that perhaps might have been better avoided, in a Work that has no other pretensions than what are purely agricultural, and having ventured there, I trust, nevertheless, that I shall not digress too widely. I would ask, that with all our great resources in land, having millions of acres not half cultivated—with an excess of capital—and with a redundancy of labour—how it is, that we are the Importers of Corn? Such a state of things, surely, cannot long exist! We have a hardy and industrious population, lying idle and starving, for want of em-

ployment, while at the same time, they are purchasing the very necessities of life from foreign countries. What! but impolitic laws! have caused this monstrous anomaly? A state of dependance that is not known in any other nation in Europe, besides Great Britain; and where too, with her mighty resources, her working classes are in the greatest misery! Her rick-yards, which ought to be full of grain, often exhibit little else but decayed staddles—her granaries, which should have been stored with grain, the produce of her own fields, and the rich reward of her own industry, are frequently crammed with foreign corn, bought with British money. She can grow grain enough, of every description to supply all her own wants, and to spare—She can grow flax and hemp, timber and dye-woods, tobacco and wool—She can raise all these, and a thousand other things, on her own soil; and by her own industry, and to her own advantage, if she were not thus most unaccountably, and most injuriously, to squander her money away upon foreigners.

I have endeavoured to point out to my brother-agriculturists, the most profitable modes of cultivation; and strongly to impress upon the Landed Proprietor, the necessity of changing some of those absurd restrictions, by which some of them have fettered their Agreements, manifestly to the disadvantage of both Landlord and Tenant; and I am convinced, that a more rational system, would soon be productive of the desired effects.

I have presumed also, to give the Government a

hint of the impolicy of trusting to foreigners for reciprocal acts of non-protecting laws, and I am convinced, that by abolishing those absurd restrictions, and putting in practice the systems I have advocated, we should, at all times, have plenty of store in our rick-yards, with an additional quantity of meat in our shambles. These are the means, and the only means, of rendering this country independent of foreigners, for her prime necessities of life, and finally to put an end to the prevailing agitation on Corn Laws.

CHAP. XXXI.

ON THE EMPLOYMENT OF THE AGRICULTURAL AND OTHER LABOURERS.

No acts of benevolence can be more laudably or more usefully exercised than those which give employment to the industrious working classes of the community. Charitable contributions, whether voluntary or not, may often provide them, in cases of distress and when in want of work, with temporary relief; but the honest, industrious English labourer, who is able and willing to work, expects, and ought to have something more permanent, and less degrading than the parish funds, or even the contributions, however kindly bestowed, of his more opulent neighbours, to depend upon. In no class of men of his own rank in any country, has more ambition been displayed to preserve his own independence, than by the British labourer. That labour was all he had to sell, and if he could dispose of it at a price to meet his necessities, he was happy and contented. Many causes, the origin of which it is not my intention now to investigate, have

contributed, most unfortunately, to plunge this meritorious and highly useful class of men into degradation, poverty, and wretchedness, unparalleled in this country, in any age, or under any circumstances. Time was, not more than half a century ago, when you found health and cheerfulness in the cottage of almost every frugal and industrious labourer in the country. The busy wheel, twirled from morning till night by the willing hands of his wife and daughters, daily proclaimed to every passing neighbour the humble comforts of his little dwelling. He had then a neat garden at his door, a pig in the sty, bacon on the rack, and some wholesome home-brewed in his cellar. What has he now? Why, from want of employment, and of being better paid when he is employed, he cannot, let him work ever so hard, earn enough to keep himself and his family from starving, and then he is at last thrown on the parish funds, where the small landholder, not much better off than himself, is called upon to contribute to his miserable maintenance. The picture I have here drawn, is not too warmly coloured; and the sole object of this chapter is to point out an easy and efficient remedy for this crying evil.

The good work of redemption, if I may be permitted to call it so, has been already begun in some parts of the country, and I do sincerely hope that I shall soon see it become general throughout the whole British Empire.

The plan is to allow every industrious labourer who wishes it, half an acre, (but I shall make my

estimate at an acre,) or some portion of land, contiguous to his own dwelling, which he may cultivate at convenient times, to enable him to maintain his family. With this view, I have drawn up the following table to shew him how this acre of land should be cultivated.—

A.	R.	P.		£.	s.	d.
0	1	0	Potatoes, 70 bushel, at 1s. 6d.			
			per bushel,.....	5	5	0
0	1	0	Beans or peas, 7½ bushel,	2	1	3
0	2	0	Wheat, 13½ bushel, at 7s. 6d.			
			per bushel,.....	5	1	3
				<hr/>	<hr/>	
				£12	7	6

Forking and picking refuse, 12s. 6d....			
Seed potatoes, 7s. 6d., seed beans, 5s. 6d.	0	13	0
Hoeing, harvesting, forking up potatoes, &c. 15s.			
Forking and picking refuse, 12s. 6d....			
Seed wheat, 11s. 3d.	0	11	3
Hoeing, harvesting, &c., 15s.,			
Deep digging the acre annually, 30s., ..			
Annual allowance for manure,	1	5	0
Rent, &c.,.....	1	10	0
Reward for labour,	8	8	3
	<hr/>		
	£12	7	6

The raising of bread corn, and food for keeping and fattening a pig should be the poor man's object, and his interest will be found in the above system, for he should be told that if he attempt to grow more potatoes he will exhaust his land instead of improving it; and if he be careful of making his straw into dung

by his pig, he will raise nearly dung enough to manure his half acre for the green crop, and by that means and the tillage above laid down, his land will be gradually improving; and the labour will be sufficient to keep any land clean whether the fork or the hoe be employed, or he may use them alternately.

Should I be asked how a poor man is to find the means to begin upon this land, I would answer,—as there is no difficulty, the task is easy.—A barrow, a spade, a three-tined fork, and a hoe, are all the implements he requires, and most labourers are possessed of a part, or of the whole of these tools already. It may, perhaps, be necessary, to plant the whole of the land with potatoes the first year, in order to pulverize and clean it; and in that case, he must dress it over with what manure he can raise. He will then require from 25 to 30 bushels of potatoes for seed; and if he be worthy enough to be indulged with a grant of the land, I think he will have but little difficulty in finding a friend to give him half a year's credit for his seed. At Michaelmas, he pays the debt by selling a part of his crop, and with another part he purchases a pig, and seed-corn sufficient to sow half-an-acre of his land for a succeeding crop; and then with forecast he will raise enough to plant his regular crop the second year.

Thus, by the grant of a small portion of land, an industrious family may derive annually a considerable sum. No one can expect, certainly, that the crops would be all clear gain, but where he has a family, the land should be so managed by them as to interfere

but little with man's daily labour. Every one is aware of the good effect that employment has upon the moral habits of mankind; and when I consider how much the comforts of a family may be increased, and the poor-rates diminished by these means, I do think, that good policy, benevolence and humanity, all loudly demand that this, or some other similar measure, for the immediate relief, and for the permanent good, of our labouring classes, should instantly be adopted, by those who have the power and means of carrying it into effect. The plan of course, would vary according to circumstances, but the principle would be productive of much good to all who came within its influence. This employment, I admit, is much better adapted to country labourers, than to those who inhabit large towns; but there are numberless smaller towns, where this plan might be acted upon with the happiest effect; and there are but very few mechanics or labourers, who stand in need of this indulgence, and deserve it, but what would delight in such an employment.

Many objections, I am aware, may present themselves against this husbandry, in consequence of the labourer not having any place at his own house wherein he can thrash his corn, and also that it will interfere materially with his daily labour. The deserving labourer, never finds any difficulty in obtaining a barn to thrash out his leased corn; and if he did, we all well know, that in some countries, the whole of the grain is thrashed out upon hempen sheets, and like-

wise winnowed in the open air; and in some parts of Devonshire, the corn is whipped out by the women and children, over poles, and by this means, the reed (straw) is preserved whole, for the purposes of covering houses, barns, and other buildings. In answer to the second objection, the digging of the land is nearly all the labour that a man will be required to do, as the rest of the work would be done by his wife and family. Nor is this digging all performed at one season of the year; and when that part of the labour should be done, it would, with respect to his employer, be in two of the most leisure months in the season. It is not an unusual thing for the labouring men in this part of the country, to rent of a farmer, or small proprietor, land, at the rate of £7. or more, an acre, to grow his potatoes, while the great landed proprietors are letting their farms, at or less than 30s. per acre.

When we reflect on the comforts that these small indulgencies will bestow on an industrious, useful, and even valuable class of society—on the happiness they will confer, on the moral good they cannot fail to effect amongst them, by the adoption of the above plan, I cannot too strongly impress the consideration of the subject upon the minds of gentlemen of landed property.

Many precedents are now to be found in different parts of the country, of the salutary effects of this system, wherever it has been adopted; but of these, I shall only mention one, which is at Holkham, in Nor-

folk; and those who have seen the villages around that princely domain, must have been struck with the neatness of the cottages and the comforts of their inhabitants. For this kindness, they are always ready to return to their benefactors, the poor man's only tender, and the rich man's best reward—GRATITUDE!

Since the former Edition of this Work was published, many of the landed proprietors in this and other parts of the country, have adopted this praiseworthy example; and here we can speak to the salutary results from our own knowledge of some of them, adjoining the pleasant and rural village, (Kenilworth); but we shall first notice Stoneleigh and Ashow, adjoining that princely domain, Stoneleigh Abbey. I can also speak to the cottagers of Lillington, Offchurch, Cubbington, Bourton, Stretton-on-Dunsmoor, Dunchurch, and Birdingbury; in fact, most of the landed proprietors in this part of the county, have allotted gardens to the deserving cottagers, and we need only to view these villages, to be satisfied with the laudable results.

CHAP. XXXII.

HORSE AND HAND-LABOUR HUSBANDRY COMPARED.

I HAVE long been of opinion that the horse-labour on a farm, is estimated in general, much too low ; or that the wear and tear, when taken into consideration at all, is not rated sufficiently high. I am likewise of opinion, that hand-labour has not been adequately appreciated ; and that the comparative expense, when all the advantages arising from it are well known, is not so much against that practice as a superficial observer may imagine. For instance, 5*d.* or 6*d.* a rod or pole, of 5½ square yards, for digging turf ten inches deep, when wages were at 2*s.* 6*d.* per day, was allowed to be a good price ; and about half that sum is now the regular price for digging stubble or loose land as deep as the plough goes. In the last estimate, I have taken a digging and a forking, at 55*s.* per acre ; that is supposing the land to have been in crop the last year. In a former part of this work, I have stated the annual expense of keeping an agricultural horse, to be £22.

10s.; and in the estimates of produce and expenses I have given the ploughings at 16s. and the necessary cartings at a price equivalent to the ploughings. By the proof or analytical sheet of produce and expenses, it will be seen that I have taken three horses as the proportional number for 80 acres of arable land, (which is rather less than is necessary to perform the work on 80 acres of close tillage;) it will then be seen, by minutely comparing the two sheets, that even that rate of charge, though it covers tradesmens' bills and wear and tear, it leaves nothing for the use of capital and superintendence; and that these estimates sufficiently prove that ploughings cost at least from 13s. to 19s. each process, and other horse-labour in proportion, when calculated upon the lowest number of horses requisite to work an arable farm.

I do not wish it to be understood that I contend that an arable farm could be mannaged by the spade culture alone. The object I have in view is to shew how near it comes to the plough in point of economy. In the last estimate, I have supposed a digging and a forking annually, or between each crop, so as to pulverize the soil, and to keep any land clean, with the use of the hoe. If we look to the common kitchen gardens, we shall find they are often planted for years in succession, with one digging only, and the land seldom gets foul, when they are properly manured and the crops well hoed; and I have no hesitation in saying, that where the land is wholly managed by the spade, the cultivation alone, ought to cost no more than 55s. per

acre. It may be seen by the former estimates, that the average expense of tillage by the plough, is about 35s. per acre, yearly crop. Now it is generally admitted, that deep tillage has great advantages over shallow ploughings; therefore I will suppose a farmer to double-dig a few acres annually, by way of employing the surplus labour, and it costs him fivepence per perch, or £3. 6s. 8d. per acre, and a shallow-ploughing, to stand him in 12s. 8d. which is 54s. per acre extra. It has been repeatedly proved, that land, when deep-cultivated or tilled by the spade, will produce one-sixth more than that cultivated in the common way, or that the extra expense is cleared in the two first crops. Admitting this, how unwise then it must be, of farmers neglecting such advantages, especially in those parishes, where labourers are on the rates, for want of employment.

CHAP. XXXIII.

ON VALUING LAND AND TITHES.

TITHES have been held sacred, and have been the established law of the land for time immemorial. They have always been considered as a part and parcel of rent, and in all cases, have been the first demanded in payment from the occupier, either in kind or as a composition, as agreed upon by the parties. It would clear away many difficulties respecting tithe, (says an intelligent and well-informed writer upon this subject,) if it were always borne in mind that tithe is itself *real* property, and not a *tax* upon property.

Since I published the first edition of this Work, an Act has been passed for the Commutation of Tithes, in England and Wales—August, 1836. I shall now endeavour to ascertain the equivalent value of tithes, as the law formerly stood, between the Tithe-holders and the Occupier, and the Proprietor of the soil and the Tithe-owner. Take page 83, for an example, where the annual amount of produce on 80 acres of arable land is shewn to be £514, and when the cost of production is taken out, the amount of rent and tithes is

£99. 8s. 4d. and when the great and small tithes have been taken in kind, the profits of the occupier, in course, have been reduced in amount, and will then stand as under :—

	£.	s.	d.
Gross amount of Produce, ..	514	0	0
Tithes on the above,	51	8	0

The amount of Rent and Tithes on the 80 acres, is £99. 8s. 4d., and when the tithes are taken in kind, that sum was reduced to £48. 0s. 4d. ; but the occupier, from being relieved of part of his expenses in harvesting, thrashing, marketing, and taxes, that portion of cost would augment the rent to the same amount. Tithes were never of so much value to any other person as to the occupier.

I shall now extract a few Sections from the above Act, bearing on the subject of Commutation.

Section 17, provides—That the Land Owners, and Tithe Owners, may attend a meeting, and proceed to make and execute a Parochial Agreement, for the payment of an annual sum, by way of *Rent-Charge*, variable as therein-after provided, instead of the Great and Small Tithes, of the parish collectively : or instead of the Great and Small Tithes, severally, to the respective Owners thereof, in the said parish.

Section 19, provides—That the proportional interest of the Owners of such Lands or Tithes, so far as relates to, their power to make any such agreement or provisional agreement, or to give any notice to the Commissioners or Assistant Commissioners, as herein-after provided, shall be estimated according to the proportional sum at which such Lands or Tithes shall be rated, to the relief of the poor, or if there shall be no such rate, according to the rules by which property of the same kind is by law rateable, to the relief of the poor.

*Section 33, enacts—*That as soon as may be after the choosing of such valuer or valuers, and after the confirmation of the said agreement, the valuer or valuers so chosen shall apportion the total sum agreed to be paid by way of Rent-charge, instead of Tithes, and the expenses of the apportionment, amongst the several lands in the said parish, according to such principles of apportionment as shall be agreed upon at the meeting, at which the valuer or valuers shall be chosen, or if no principles shall be then agreed upon for the guidance of the valuer or valuers, then, having regard to the average Titheable produce and productive quality of the lands, according to his or their discretion and judgment, but subject in each case to the provisions herein-after contained, and so that in each case the several lands shall have the full benefit of every modus and composition real, prescriptive and customary payment, and of every exemption from or non-liability to Tithes relating to the said Lands respectively, and having regard to the several Tithes to which the said lands are severally liable; provided that it shall be lawful for the said valuers, when an even number is chosen, by any writing under their hands, to appoint an umpire before they proceed upon the business of such apportionment, and the decision of the umpire on the questions in difference between the valuers shall be binding on them, and shall be adopted by them in the apportionment.

*Section 37, enacts—*That in every case in which the Commissioners shall intend making such award, notice thereof shall be given in such manner as to them shall seem fit; and after the expiration of twenty-one days after such notice shall have been given, the Commissioners or some Assistant Commissioner shall, except in the cases for which provision is herein-after made, proceed to ascertain the clear average value (after making all just deductions on account of the expenses of collecting, preparing for sale, and marketing where such Tithes have been taken in kind,) of the Tithes of the said parish, according to the average of seven years preceding

Christmas, in the year one thousand eight hundred and thirty-five : provided that if during the said period of seven years, or any part thereof, the said Tithes or any part thereof shall have been compounded for or demised to the owner or occupier of any of the said lands in consideration of any rent or payment instead of Tithes, the amount of such composition or rent or sum agreed to be paid instead of Tithes, shall be taken as the clear value of the Tithes, included in such composition, demise, or agreement, during the time for which the same shall have been made ; and the Commissioners or Assistant Commissioner, shall award the average annual value of the said seven years, so ascertained, as the sum to be taken for calculating the rent-charge, to be paid as a permanent commutation of the said Tithes : provided, also, that whenever it shall appear to the Commissioners, that the party entitled to any such rent or composition, shall, in any one or more of the said seven years, have allowed and made any abatement from the amount of such rent or composition, on the ground of the same having in any such year or years, been higher than the sum fairly payable by way of composition for the Tithe, but not otherwise, then and in every such case such diminished amount, after making such abatement as aforesaid, shall be deemed and taken to have been the sum agreed to be paid for any such year or years ; provided also, that in estimating the value of the said Tithes the Commissioners or Assistant Commissioner shall estimate the same without making any deduction therefrom on account of any Parliamentary, parochial, county, and other rates, charges, and assessments to which the said Tithes are liable ; and whenever the said Tithes shall have been demised or compounded for, on the principle of the rent or composition being paid free from all such rates, charges and assessments, or any part thereof, the said Commissioners or Assistant Commissioner, shall have regard to that circumstance, and shall make such an addition on account thereof, as shall be an equivalent.

Section 40, enacts—That in case any of the lands in the parish, shall be hop-grounds, orchards, or gardens, and notice shall be given by the owner thereof to the Commissioners, or Assistant Commissioner, acting in that behalf, that the Tithes thereof should be separately valued, the Commissioners or Assistant Commissioner shall estimate the value of the Tithes thereof according to the average Rate of composition for the Tithes of hops, fruit, and garden produce respectively during seven years preceding Christmas in the year one thousand eight hundred and thirty-five, within a district to be assigned in each case by the Commissioners or Assistant Commissioner, and estimating the same as chargeable to all Parliamentary, parochial, county, and other rates, charges, and assessments to which the said Tithes are liable, and shall add the value so estimated to the value of the other Tithes of the Parish ascertained as aforesaid.

Section 57, provides—That every Rent-charge charged upon any lands by any such intended apportionment shall be deemed at the time of the confirmation of such apportionment, as herein-after provided, to be of the value of such number of Imperial bushels and decimal parts of an Imperial bushel of wheat, barley, and oats as the same would have purchased at the prices so ascertained by the advertisement to be published immediately after the passing of this Act, in case one-third part of such Rent-charge had been invested in the purchase of wheat, one-third part thereof in the purchase of barley, and the remaining third part thereof in the purchase of oats, and the respective quantities of wheat, barley, and oats so ascertained shall be stated in the draft of every apportionment.

Section 58, provides—That the Rent-charge may be specially apportioned.

By *Section 59*, Commissioners may employ Surveyors, and have the power of valuers, as to entry in lands, &c.

Section 61—Empowers Commissioners to hear and determine objections to apportionment.

Section 62, enacts—That owners of Lands chargeable with Rent-charge may give land instead thereof.

Section 67, provides — That Lands to be discharged from Tithes, and Rent-charge paid in lieu thereof.

By *Section 68*—Lands to be free from Tithes when lands are given in lieu thereof.

Section 69—Rent-charge to be liable to parochial and county rates.

Section 71—Rent-charge to be subject to the same incumbrances and incidents as Tithe before this Act.

Section 90—Act not to extend to Easter-offerings, &c. or to permanent Rent-charges by custom or Act of Parliament.

By these Sections, we find the Tithes are still one-tenth of the produce, subject to deductions on harvesting and converting the crop into cash, Government and parish taxes; and when allowances are made for barn-rent, risk in harvesting, and other incidental matters, we shall find two-thirds of the gross amount to be about a fair estimate.

The proportions will stand as under :—

RECTOR'S CLAIM.						
	£.	s.	d.	TITHES.		
10 Acres of beans,	82	10	0			
10 Ditto of wheat,	101	5	0			
10 Ditto of fallow,	0	0	0			
10 Ditto of wheat,	101	5	0			
10 Ditto of barley,	80	0	0			
Straw, when taken in kind						
£2. per acre,	80	0	0			
	<hr/>			£.	s.	d.
	£445	0	0	—44	10	0
One-third deducted,				14	16	8
	<hr/>					
Net tithes,	£29	13	4			
Per acre,	0	7	4 $\frac{3}{4}$			

VICAR'S CLAIM.

	£.	s.	d.	TITHES.
10 Acres of clover,.....	53	10	0	
20 Ditto of grass,	45	10	0	
Pigs, poultry, &c.	10	0	0	
	<hr/>	<hr/>	<hr/>	
	£109	0	0	—10 18 0
One-third deducted,.....		3	12	4
		<hr/>	<hr/>	
Net tithes,	£7	5	8	
Per acre,.....	0	1	9 $\frac{3}{4}$	
	£.	s.	d.	
The Rector's Rent-charge, ..	29	13	4	
The Vicar's ditto,	7	5	8	
The Occupier's Rent,	62	9	4	
	<hr/>	<hr/>	<hr/>	
	£99	8	4	

The rectorial tithes on 50 acres, according to the foregoing table, amount to 7*s.* 4 $\frac{3}{4}$ *d.* per acre. Sixpence a bushel on wheat, rise or fall, and on other grain in proportion, will amount to 8*d.* per acre, and in the rent, of course, to 6*s.* 8*d.* per acre, one way or the other. Grass-land, raising 130 lbs. of meat annually, or other produce in proportion, is about equal in quality to land that grows 27 bushels per acre of wheat; and one penny per pound, rise or fall, on meat, cheese, or any other produce in the same proportion, will raise or lower the rent and the vicarial tithes in the manner above stated; and the same effect will be the result on all other land according to the crop it produces.

I should here remark, that both rent and tithe run higher or lower, according to the system adopted. It may be seen by the tables from which these estimates are taken, that there is only one fallow, or barren year,

in eight; and every scale beneath that, tends to lower both rents and tithes, in proportion to the repetition of the fallows, or the custom of the neighbourhood.

Tithes must naturally advance with the practical and scientific improvements that take place in agriculture. Vicarial tithes on the light land, before the introduction of the turnip and clover husbandry, were not of half the value they have been since that time. It has been shewn, in a former part of this work, that the profits of the farmer are very much augmented by growing cattle crops between his corn crops, alternately, and as this system advances, the vicarial tithes will consequently increase. The farmer's profits and the Vicarial Tithes will rise together upon the the heavy soils, when they are cultivated on a similar system.

Tithes, as I have before observed, are never of so much value to any other person as they are to the occupier; and when they are forcibly taken off his farm, it must inevitably be injurious to both him and to the estate. A fixed composition, as an equivalent, must certainly be an adjustment the most equitable and satisfactory to all parties. No Occupier can annoy or injure a Tithe-owner, without suffering an equal annoyance and injury himself. When shambles meat was 9*d.* per lb. an extraordinary quantity of tilled land was laid down in grass, but now the price of meat is so much lower, that system undoubtedly will have a re-action,

CHAP. XXXIV.

ON VALUING THE PROPERTY IN A PARISH, FOR THE PURPOSE OF EQUALIZING THE PAROCHIAL RATES.

THE principle on which parish rates are now made, is on the productive value of each species of property; or, in other words, the clear annual productive value.

And in order to make the subject still plainer to the young valuer, it may perhaps be necessary to quote those passages of the law, which refer to those species of property that are, and that are not rateable; and to what is allowable as a drawback; and to what is not allowable.

Mr. Nolan says—"The assessments for a Poor's-rate are made from year to year, with reference to an ascertained gone-by profit, and made according to the improved or diminished value of the subject matter of the assessment, at the time of making the rate. And the principle upon which real property is now assessed, is that the tax shall be imposed on the actual productive value of the particular subject, at the time of making the rate, whether that is more or less than what it had been when the former rate was made." Again, he recommends the rate to be rather below than above the productive value.—3d edit. 198. *The King v. Parrot and others.* 5 T. R. 595.—*Mr. Witherds.*

And it appears very clear, by a variety of cases decided in the Court of King's Bench—"That every thing should be allowed as a drawback, which is necessarily expended, in order to render the subject matter of rate productive; and whether it goes to the landlord in the name of rent, or the tenant as profit, or to the occupant proprietor, who stands in the place of both, is the legitimate of tax in the hands of him who occupies the land or property."

It has long been decided, that money at interest, is not rateable, neither is the work of a man's hands, nor the ingenuity of his head. No property can be rated in a double shape, or in another person's hands. And it appears, that personal property of any kind, is not rateable, such as stock in trade, or moveable machinery; but all property, attached to the freehold, is deemed a part of the freehold; such as steam-engines, water-pipes, gas-pipes, canals, brick-kilns, lime-kilns, and mines of all descriptions, &c.—Now it is necessary to inquire what are the different species of matter that are required to render the subject matter of rate, and what are the materials subject to drawbacks.

On land—seed and labour of all descriptions, manure, implements of wear and tear, money employed, and superintending the farm, are all necessary to render the matter of rate productive; and as the productive value must be clear, it seems all taxes and rates are necessarily a drawback to render the productive value clear; and also to avoid any part being rated in a double shape.

The productive value of houses, or other buildings, is simply the rent, or what they are worth to rent, subject to all the drawbacks as above necessary to render the matter of rate productive and clear; such as repairs, taxes, and rates. And as the allowance for repairs must necessarily be thrown into an annual sum, a scale of per centage should be adopted, and applied according to the state of such buildings, seems to be the most correct way of bringing all to an equal rate.

Coal and all other mines, are in course subject to the same drawbacks, as buildings, &c., and though there may be steam-engines, or other machinery, yet they form a part of the freehold, and are perhaps necessary to render the matter of rate productive, but it cannot be rated beyond the clear productive value of the whole connected concern. The same in brick or lime-kilns, they cannot be rated beyond the clear profits on the mine; for to rate the profits without deducting the interest on the capital employed, would be rating personal property. And in manufactures, it seems it is the clear profit on the buildings and that part of the machinery which is fixed to the freehold that is rateable; and not any part of the moveable appendages, for that would be rating stock in trade.

I believe it has been said, by one of the former Judges, "That the stock on a farm is not rateable, but stock in trade was rateable." But if such was the law, it would be impracticable to act on it under present circumstances, particularly in towns.

The farm of 360 acres, cultivated in the customary

way, leaves a clear rent of £482. 4s. 9d. but that sum, it should be understood, is not the whole productive value, and it appears from the preceding quotations, that a part of the occupier's interest on the farm is liable to be charged to the rate. But it may be seen by the former estimates, that the occupier requires for his remuneration on the 360 acres, £526. 4s. 9d. that is, £130. 4s. 9d. for interest of capital, £126. for superintendence, £270. as profit for housekeeping, &c. &c., which last sum, where a parish-assessment is made to its productive value, will form a part with the rent, and stand as under :—

	£.	s.	d.
Landlord's interest,	482	4	2
Occupier's ditto,	270	0	0

At the same time the law requires that all property should bear its equal proportion, and it would appear unequal to assess an occupier of land for his profits unless the occupiers of houses, where there is a trade to them, were assessed for their profits. But this does appear to be the case in the county rates; or in those counties where the rate was regulated by the property-tax, for that tax included (what was called) profits on trade and property, and profits of all descriptions, and this tax does appear to bear harder on the land than on other property. And probably there is no more equable mode of making a parish assessment, than being governed by what each species of property is worth to rent. Since the former Edition of this Work was published, that part of the Act that affected personal property, or profits on trade, has been repealed.

In the foregoing assessment, it will be seen, that buildings, or perishable property, are reduced one-sixth, and land one-twelfth, but this should be taken only for example; rates are much higher in some parishes than others: the allowance for repairs, should also vary according to circumstances, but this may be considered in estimating the value for rent; new buildings, or those in a good state of repair, are worth more to rent, than those in a worse or dilapidated state; situation is also to be taken into consideration.

Land near towns is generally of more value, than that of a similar quality, at a distance from a town, and whether we take its value from what small lots are worth to let in such situations, or whether we consider them at their productive value, in either case, there is no drawback required for superintendence nor capital; in consequence, the amount of an assessment will be that much higher. For instance, if we consider the five acres in the foregoing assessment, as what is termed accommodation land, that is, what is detached from any farm, it would stand in an assessment as under:—

	£.	s.	d.
Value of produce,	16	12	6
Taxes, 4s. in the pound, repairs to fences, &c., drains, &c.,	4	2	6
	<hr/>		
Clear annual value,	£12	10	0
	<hr/>		

	£.	s.	d.
House and garden,	26	5	0
Taxes, 4s. in the pound, £4. 4s. 0d.			
repairs, 5 per cent., £1. 1s. 0d.	5	5	0
Clear annual value,	£21	0	0

Meadow, 5 acres, hay and aftermath, &c.,	26	15	6
Taxes, 4s. in the pound, repairs, &c., to fences and drains, £4. 2s. 6d., an- nual allowance for manure, 30s., harvesting, hay, &c.,	14	5	6
Clear annual value,	£12	10	0

CHAP. XXXV.

ON TENANCY, OR HOLDING FARMS.

THE covenants between Landlord and Tenant, should be such as to ensure a gradual improvement on the farm. The interest of landlord and tenant are so riveted together, that it is impossible for any tenant to give an advantage to his landlord, by enriching his farm, without receiving a part of the benefit himself, and *vice versa*. But it cannot reasonably be expected, that a tenant would underdrain, raise fences or effect alterations and repairs in buildings, without a liberal allowance for materials, or a security for holding his farm for a term of years.

Draining, marling, sanding, burning or torrifying strong earths, making water-meadows, &c. are often a permanent improvement, and should be encouraged, either by lease, or by refunding a sum adequate to such an expenditure, either by the landlord, or a coming-on tenant, that time may not allow the going-off tenant to enjoy. Farms often lay in an unimproved state for ages, to the great injury of both landlord and tenant, for want of such covenants; and these expen-

ditures, though heavy in the first instance, are not unfrequently repaid in a very short period.

The custom between coming-in and going-out tenants, varies in almost every county or district. In some they are oppressive and unreasonable, either to one party or the other, and are often productive of some unpleasant irregularities at the latter end of a term; and originate, in many instances, serious disputes. Nothing can be more reasonable, than that every going-off tenant should be paid for all the necessary labour he has done on a farm, that is consistent with regularity and justice. And nothing is more easy for men of experience to award a reasonable remuneration to a tenant for his labour, or to adjudge him to pay damages for any dilapidations or injury he may have committed.

I have previously had cause to remark that horse-labour on a farm has frequently been laid too low, and that a going-off tenant, in consequence, has not been paid enough for his labour. The going-off tenant is fairly entitled to be paid such a sum as will not only remunerate him for the hire and labour of his men and horses, but the wear and tear of his implements, taxes, interest on capital, and superintendence. The young valuer will find every requisite information in the estimates, pages 392-3-4, the proportions from which he may adapt to any valuation.

CHAP. XXXVI.

ON DAIRYING.

I THINK I may safely premise, that no department of the husbandry business is more subject to variation than this; but where the land is well adapted to the purposes of making either butter or cheese, it often forms the most profitable branch of the farmer's establishment. Some land that will produce good butter, is not well calculated for cheese; and there is but little land, that produces good flavoured cheese, but what will also produce good butter. Some cows, it is well known, will produce more milk than others, while others again will give richer milk.

I have stated, in pages 88 and 89, the average of twenty cows to make 3 cwt. 3 qrs. of cheese each, but this is a very moderate quantity of produce for a well-managed dairy. A Cheshire dairyman says, it requires 100 quarts of milk to make a cheese of 39 lbs. Now, supposing a dairy of 20 cows, giving 9 quarts per day, on the average of 26 weeks, or 32,760 quarts, allowing 100 qts. to make 30 lbs. of cheese, will be 4 tons, 7 cwt. 3 qrs. and allowing the same quantity of milk to make half the weight in butter, the estimate value of milk, cheese, butter, and calves, will be as follows:—

	£.	s.	d.
8,190 gallons of milk, at 12d. $\frac{1}{4}$ gal.	409	10	0
Calves, 30s. each,	30	0	0
	<hr/>		
	£439	10	0

	£.	s.	d.
4 tons, 7 cwt. 3 qrs. at 56s. $\frac{1}{4}$ cwt.	245	14	0
Calves, butter, and whey,	70	0	0
	<u>£315</u>	<u>14</u>	<u>0</u>

409 $\frac{1}{2}$ dozens of butter, at 12s. $\frac{1}{4}$ doz.	245	14	0
	70	0	0
	<u>£315</u>	<u>14</u>	<u>0</u>

Butter-making, it is generally allowed, will return a better profit than cheese, because the skimmed milk is more fattening to porkers than the whey. Yet I am inclined to think, there is but very little difference in the value of the offals, as the whey-butter and the whey, in a well-managed dairy, is often worth as much money, as the skimmed milk is worth for feeding porkers. Eighteen pounds of butter, has been made from a week's whey, from twenty cows, for a short period, in the favourable part of the summer. Sixpence per lb. for green or factor's cheese, is perhaps, a higher proportion, than 12*d.* per lb. for butter; and besides, there is more trouble and expense in managing a cheese dairy, than there is when butter only is made.

The retailing of new milk, is generally allowed to be more profitable than making cheese or butter, but we find that 3*d.* a quart, does not realize quite 25 per cent. more than making the milk into cheese or butter, but when we consider the expense of carrying to market and selling, the waste in measuring, and the disappointments in the sale, perhaps that business may not be much more profitable, than making either butter or cheese.

Cows are profitable under the worst management, and few will deny, but the profits of the dairy are increased or diminished, in proportion to the attention, skill and management of the dairy woman ; but much depends on the out-door management.

Directions for managing a Dairy of Cows.

At six o'clock in the morning in the winter, give each cow half-a-bushel of sliced wurzel or steamed potatoes, or the whole mixed together, sprinkled with a little salt, or by way of change, a little malt-dust—at seven o'clock, the time of milking, give each cow some of the greenest best hay, the farm produces, if she refuses hay, give her something she will eat, such as cabbage, or grains mixed with bran : as soon as they are milked in the morning, turn them into a croft where there is plenty of good water—at twelve o'clock, give each cow three gallons of the mixture as before, or less if she refuses to eat it—at two o'clock, clean the troughs, give a second feed of wurzels, cabbage, or steamed potatoes and bran—at four o'clock, put the cows into the stalls to be milked, and feed with green hay while milking, as before ; this amuses the cow, and induces her to give her milk more freely—at six o'clock, repeat the food, as in the morning, and sup them up at eight o'clock. In the summer, their food should be lucern, clover, vetches, and meadow grass, mowed and brought home to them ; cows fed and treated in this manner, have been known to make a third more profit, than when treated in the common way.

CHAP. XXXVII.

GENERAL OBSERVATIONS.

It will be seen by estimates, inserted in a former part of this Work, that good turnip soils, and good wheat and bean land, cultivated on the favourite custom of the country, that is, alternate tillage and grass, and taking wheat at 60s. per quarter, and other crops in the same proportion, and parish taxes at four shillings in the pound, will produce a clear rent or profit, beyond the cost of production and occupier's remuneration, from 23s. 10d. to 25s. 4d. per acre. It will likewise be seen, that such lands, cultivated on the alternate system of a cattle and corn crop, keep equally as much, or more stock, and leave, on the same scale of produce and expenses, a clear rent or profit of upwards of 45s. per acre. In the tables, (pages 93, 95, and 97,) it is estimated that poor grass land, makes a clear profit of 12s. 6d. per acre, but when cultivated on the old fallow system, and on the above scale of prices and expenses, leaves little or no profit, beyond the cost and occupier's remuneration. But when cultivated on the alternate course of corn and cattle crops, more stock is kept than when in grass, and then a clear rent

occurs of 32s. per acre ; (page 139.) In another comparison, on an inferior soil, which I term wheat and oat land, nearly the same results are obtained. By another calculation, I have demonstrated how the arable farmer may keep as much, or more stock, on the same kind of land, than the grazier. And further, in the arable system, the cattle crops are of a more nutritious quality when grown on land rich by nature ; in the same proportion as grass, when grown on good is of a more feeding quality, than when grown upon poor land. These observations, I trust, will convince the agriculturist, of the advantages which a well managed arable farm has over a grass farm.

Stock is, or ought to be, the first thing to be attended to on all farms, where improvement is the primary object. A regular and well-digested system of management is indispensable, in the breeding, improving, and feeding of stock, and in furnishing the means necessary to accomplish this end, the arable farms are greatly superior to those which lay in grass, as the food for the stock is raised in regular succession throughout the year ; while the produce on the grass farm, is principally confined to the summer months. Whether a farm be all arable, or part grass and part arable, the economy in improving the farm, or in keeping improved land in condition, will be found in growing and consuming the greatest weight of cattle crops.

This question, then naturally presents itself, how is it that so much land should be in grass, while more stock can be maintained on the arable system, and with

a greater profit to the occupier ? In a preceding part of this Work, I have stated the cause to have arisen in the imperfect mode of tillage, which prevailed a century or century and a half ago. The imperfection I have alluded to, is sufficiently proved by the great increase of population, which is now supported on a decreased breadth of cultivated soil ; for though great quantities of waste land have been brought into cultivation during that period, yet land, as it became improved, continued to go into grass, even when grain has been at the highest price ; and when any impediment affects the plough, it must naturally diminish the produce of the soil, in butcher's meat as well as in other things, but it must also lessen the demand for labour.

One of the impediments formerly complained of, was the Tithe-laws. But the effect of those laws was nothing, when placed in comparison with the free admission into this country of foreign corn ; for should the Government ever be so far deluded by the advocates of free trade, as to admit foreign corn, free of duty, that would stop the plough at once ; and I need not here enumerate what would be the consequences of such a measure. One result of the restrictive system is, to give confidence to the grower, which of course encourages the growth of corn. But both corn and every other description of produce, as shewn in former estimates, might be raised in great abundance, for a much larger population than we have at present ; and perhaps, with the improved machinery at this time, at a lower price, (in proportion to the advanced price on cultivation,)

than it was raised a century or century and a half ago ; and it must be evident to every one, that no other means can be devised, to return fair profits to the grower, and afford cheap provisions to the consumer, than an improved cultivation.

We have, it must be admitted, all the resources at hand, viz., land, labour, and capital, in excess, to raise this consumption. Every one, who has travelled through any part of the country, and directed his attention to the subject, must have observed, that the great bulk of the land is in grass ; and I affirm, that millions and millions of quarters of corn, might be annually grown in England, without reducing the quantity of shambles meat or other produce ; though nothing but an improved culture, such as will give the balance of profit in favour of the plough over the grass, will again fill our rick-yards, (the best of all store-rooms,) with abundance, and probably, at all times, sufficient to meet the demand of the country.

A change of habits, (as I have elsewhere observed,) often requires a change of customs ; and although there is no doubt, but the present system of cultivation is much improved, when compared with former modes, it is evident that the partiality for grass has become too great to suit the present habits and wants of the country.

A century or century and a half ago, when wheat was sold at 40s. a quarter, or less, with a profit to the grower, the heavy land was the principal soil on which wheat was then grown ; but the additional expenses of cultivation, and the introduction of the turnip and

clover husbandry, will account, in part, for the land going out of cultivation. The alternate mode of plough and grass, then became the favourite system, but now the time is come, when an alteration is absolutely called for. When the minds of men have long been rivetted, as it were, to any particular custom, it is not an easy task to remove their prejudices; and reason itself has often been foiled in the attempt. By improving the culture, arable and grass farms would regulate themselves, and old grass lands would be broken up as they were wanted; but the quantity of land in tillage, need not be increased, and the corn that might be grown, would probably render the present corn laws at all times effectual or neutral.

An extended breadth of culture, would, in some measure, relieve the poor-rate, and by increasing the demand for labour, would so far amend the condition of the labourers; although it would not remove all the evils of which they now complain; but what good this alteration in the system of cultivation could not effect, other means, which are now in progress, may ultimately complete. There is land enough in every part of the kingdom, that would produce three or four times the value of their present crops, if it were allotted in small parcels to every industrious and deserving labourer. The good work is already begun, and the laudable example has been set by many of our Nobles and others, an example, I hope, that will be followed by every Nobleman and Gentleman in the country; and I will maintain, if this plan be conducted upon well-

regulated principles, it will have the effect of restoring to that meritorious and useful class of society, their comforts and moral habits.—In another part of this Work, I have stated, to what amount a family may be benefited, annually, by having a grant of an acre of land.

A little plough land is a great acquisition to a grass farm, as it furnishes litter for the stable and stalls, and saves the grazier the expense of buying straw ; and whatever may be the quantity of land he has in plough, it should be cultivated in eight equal divisions, one half being employed in growing corn-crops, and the other half in raising vegetables for the use of the stock. The landlord, if he adopt proper restrictions for manuring and keeping the land clean, need not be under any fear of having his land injured by such a course of cropping. In fact, I have no hesitation in saying, that in all grazing districts, as much land ought to be tilled, as will employ the labourers belonging to each parish, and that such a regulation would be mutually advantageous to the master, the labourers, and the parish.

CHAP. XXXVIII.

HEALTH, PATRIOTISM, AND RURAL EMPLOYMENT COMBINED.

THE small occupier, or tradesman, derives many conveniences, and I may add comforts, in being able to keep his horse, cow, and pig. Now it is well known that it requires seven acres of the middling kind of grass land to supply a horse and a cow with plenty of grass in the summer, and with hay in the winter. I have, however, by the statement given below, endeavoured to prove that half that quantity of land is more than sufficient to keep them on cultivated plants.

ACRES.

- $\frac{1}{2}$ Lucern, 15 tons is 200 lbs. $\wp$ day, from the 15th of May to the 1st of November, 168 days.
- $2\frac{1}{2}$ Sainfoin, 3 tons 15 cwt. of hay, is 42 lbs. per day for 197 days.
- $\frac{1}{4}$ Mangel-wurzel, 5 tons is 50 lbs. per day for 224 days.
- $\frac{1}{4}$ Potatoes, 2 tons 5 cwt. is 14 lbs. per day for 360 days.

This quantity of lucern, and sainfoin hay, with part of the wurzel, will keep a middle-sized horse and cow the whole year; and the potatoes and part of the wurzel will be sufficient to feed three or four porkers

Twelve pounds of wurzel per day, is enough for a cow at the commencement of the winter, and may be progressively increased to double that quantity in the spring. As I have had no experience in feeding horses with wurzel, I should recommend that part of the quarter of acre, be planted with Swede turnips, instead of wurzel, which are about equal to carrots, as food for horses.

24 lbs. of hay, and 10 lbs. of chopped Swedes per day, is food sufficient for a middle-sized horse out of work, but corn should be added to this food, when at work, in proportion to the labour which he is required to perform.

Poultry, of every description, may be fattened with boiled or steamed potatoes and wurzel; but if they are required to be fattened quickly, this food should be mixed with a little meal.

I have before stated, that to keep land clean with the spade, fork, and hoe, would cost in labour about 55s. per acre, annually. The lucern and sainfoin should be planted in rows, and the spaces between well forked twice in the season, which will cost about 50s. per acre. The cost in cultivating the three acres and a half, will then stand thus:—

ACRES.	£.	s.	d.
$\frac{1}{4}$ of Potatoes,.....	0	13	9
$\frac{1}{4}$ of Wurzel or Swedes,.....	0	13	9
3 of Lucern and Sainfoin,.....	7	10	0
	<hr/>		
	£8	17	6
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APPENDIX.

AN ACCOUNT OF THE RESULTS OF EXPERIMENTS ON
THE PRODUCE AND NUTRITIVE QUALITIES OF
DIFFERENT GRASSES, AND OTHER PLANTS, USED
AS THE FOOD OF ANIMALS ; INSTITUTED BY
JOHN DUKE OF BEDFORD.

INTRODUCTION.

OF the 215 proper grasses, which are capable of being cultivated in this climate, two only have been employed to any extent for making artificial pastures, rye-grass and cock's-foot grass ; and their application for this purpose, seems to have been rather the result of accident, than of any proofs of their superiority over other grasses.

A knowledge of the comparative merits and value of all the different species and varieties of grasses, cannot fail to be of the highest importance in practical agriculture. The hope of obtaining this knowledge, was the motive that induced the Duke of Bedford to institute this series of experiments.

Spots of ground, each containing four square feet, in the garden at Woburn Abbey, were inclosed by boards, in such a manner, that there was no lateral communication between the earth included by the

boards and that of the garden. The soil was removed in these inclosures, and new soils supplied ; or a mixture of soils, was made in them, to furnish as far as possible, to the different grasses, those soils which seemed most favourable to their growth ; a few varieties being adopted for the purpose of ascertaining the effect of different soils on the same plant.

The grasses were either planted or sown, and their produce cut and collected, and dried at the proper seasons, in summer and autumn, by Mr. Sinclair, his Grace's gardener. For the purpose of determining, as far as possible, the nutritive powers of the different species, equal weights of the dry grasses or vegetable substances were acted upon by hot water, till all their soluble parts were dissolved ; the solution was then evaporated to dryness by a gentle heat in a proper stove, and the matter obtained carefully weighed. This part of the process was likewise conducted with much address and intelligence, by Mr. Sinclair, by whom all the following details and calculations are furnished.

The dry extracts, supposed to contain the nutritive matter of the grasses, were sent to me for chemical examination. The composition of some of them is stated in a former part of this Work. It will be found from the general conclusions, that the mode of determining the nutritive power of the grasses, by the quantity of matter they contain, soluble in water, is sufficiently accurate, for all the purposes of agricultural investigation.

The under Experimental Details on Grasses, are selected from Mr. Sinclair's Tables.

1. *Anthoxanthum odoratum*. — Sweet-scented vernal grass. Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt. qrs. lbs.		Cwt. qrs. lbs.	
The produce per acre at the time of flowering, the 20th of April, ..	67	3 17—1	0	10
The lattermath, produce of grass per acre,	60	3 2—2	0	15

This is an early flowering grass, and accumulates in its nutritive qualities, nearly two-thirds, before the seed is ripe. The smallness of the produce of this grass, renders it improper for the purpose of hay; but its early growth, and the superior quantity of nutritive matter which the lattermath affords, compared with the quantity afforded by the grass at the time of flowering, causes it to rank high as a pasture grass, or for hay, at the time the seed is near ripe, (21st of June,) on such soils as are well fitted for its growth; such are peat-bogs, and lands that are deep and moist.

2. *Holcus odoratus*. — Sweet-scented soft grass; flowers the 20th of April. Nat. of Germany.

The produce of this grass at the time of flowering, from a rich sandy loam, is	85	0 8—5	1	22
The lattermath,	151	3 19—10	0	10

This, like the above, is an early flowering grass, and accumulates in weight of grass, nearly two-thirds, at the time the seed is ripe, (25th of June,) and upwards of two-thirds, in its nutritive properties; it is a tender grass, and the produce in the spring is inconsiderable. If, however, the quantity of nutritive matter which it affords, be compared with any of those species which

flower nearly at the same time, it will be found greatly superior. It sends forth but a small number of flower stalks, which are of a slender structure compared to the size of the leaves. This will account in a great measure for the equal quantities of nutritive matter afforded by the grass at the time of flowering, and the lattermath.

4. *Alopecurus pratensis*.—Meadow fox-tail grass, flowers the 20th of May. Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
The produce of grass from a clayey loam, at the time of flowering, is	182	1 6—4	1	2
The lattermath,	72	3 19—2	1	3

This grass produces a bulky crop at the time of flowering, and loses but little of its nutritive properties, owing to its being an early grass, till after June 20; it then becomes of little value as hay, compared with the *Holcus odoratus*: its nutritive value is as 4 to 10 only.

7. *Avena pubescens*.—Downy oat-grass, flowers June the 13th. Nat. of Britain.

The produce of the grass from a rich sandy soil, is	139	3 2—3	1	2
The lattermath,	60	3 2—1	3	17

This grass loses half its nutritive properties, by standing till the seed be ripe; it seems well calculated for permanent pastures; it is hardy, early, and more productive than many others which affect similar soils and situations.

8. *Poa pratensis*.—Smooth-stalked meadow grass. Nat. of Britain.

At the time of flowering, May 30, the produce from a mixture of bog-earth and clay, grass per acre, ..	91	0 17—2	1	27
Aftermath per acre,	36	1 23—1	0	0

This grass loses nearly one-fourth of its value by leaving the crop till the seed be ripe, the 14th of July. This species sends forth flower-stalks but once in a season; and these being the most valuable part of the plant for the purpose of hay, it will, from this circumstance, and the superior value of the grass of the latter-math, compared to that of the seed-crop, appear well adapted for permanent pastures.

11. *Poa trivialis*. — Roughish meadow grass. Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
The produce at the time of flowering, the 13th of June, from a light brown loam, with manure, is....	76	2 20—2	0	10
The aftermath,	42	2 4—1	3	27

This grass accumulates nearly one-third more in value by being left till the seed is ripe, the 10th of July. Its superior produce, the highly nutritive powers which the grass seems to possess, and the season in which it arrives at perfection, are merits which distinguish it as one of the most valuable of those grasses, which affect moist rich soils, and sheltered situations; but on dry exposed situations, it is altogether inconsiderable; it yearly diminishes, and ultimately dies off, not unfrequently in the space of four or five years.

12. *Festuca glauca*. — Glaucous fescue-grass. Nat. of Britain.

The produce at the time of flowering, the 13th of June, from a brown loam, is	85	0 8—3	3	26
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The proportional value by which this grass at the time of flowering exceeds that at the time the seed is

ripe, the 10th of July, is as 6 to 12, or one-half of its nutritive properties lost. Directly the reverse of that of the preceding species, and affords another strong proof of the value of the straws in grasses which are intended for hay. The straws at the time of flowering are of a very succulent nature; but from that period till the seed be perfected, they gradually become dry and wiry. Nor do the root-leaves sensibly increase in number or in size, but a total suspension of increase appears in every part of the plant, the roots and seed vessels excepted. The straws of the *Poa trivialis* are, on the contrary, at the time of flowering, weak and tender; but as they advance towards the period of ripening the seed, they become firm and succulent: after that period, however, they rapidly dry up, and appear little better than a mere dead substance.

13. *Festuca glabra*. — Smooth fescue-grass. Nat. of Scotland.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, June 16th, the produce of this grass from a clayey loam, with manure, is ..	127	2 13—3	3	26
The lattermath, is.....	52	2 5—0	1	20

The proportional value which the grass at the time the seed is ripe, bears to that of the crop at the time of flowering, is as 5 to 8.—The proportional value which the grass of the lattermath bears to that of the crop, at the time of flowering, is as 2 to 8, and to that of the crop at the time the seed is ripe, is as 2 to 5.

The general appearance of this grass is very similar to that of the *Festuca duriuscula*: it is, however, specifically different, and inferior in many respects, which will be manifest on comparing their several pro-

duce with each other; but if it be compared with some others, now under general cultivation, the result is much in its favour, the soil which it affects being duly attended to. The *Anthoxanthum odoratum*, being taken as an example, it appears that

Festuca glabra affords of nutritive matter—

	Weight of grass per acre.			
	Cwt.	qrs.	lbs.	Cwt. qrs. lbs.
From the crop at the time of flowering,	3	3	26	} 5 2 16
At the time the seed is ripe,.....	1	2	18	

Anthoxanthum odoratum,—

At the time of flowering,	1	0	10	} 3 3 13
At the time the seed is ripe,.....	2	3	3	

The weight of nutritive matter which is afforded by the produce of one acre of the *Festuca glabra*, exceeding that of the *Anthoxanthum odoratum* in proportion nearly as 6 to 9,.. 1 3 3

14. *Festuca rubra*. — Purple fescue-grass.
Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs.	lbs.	Cwt. qrs. lbs.
At the time of flowering, June 20, the produce from a light sandy soil, is	89	0	1—2	0 15
The aftermath, is	30	1	15—0	2 23

This grass loses nearly one-third of its value by being taken at the time of flowering. The quantity of nutritive matter is at the time the seed is ripe, the 10th of July, 3 cwt. 0 qr. 4 lbs.

15. *Festuca ovina*. — Sheep's fescue-grass.
Nat. of Britain.

At the time the seed is ripe, the 10th of July, the produce per acre, ..	48	2	13—1	0 15
Produce of lattermath per acre, is ..	30	0	15—0	2 10

The dry weight of this species was not ascertained, because the smallness of the produce renders it entirely unfit for hay. If the nutritive powers of this species be compared with those of the preceding, the inferiority will be nearly as 3 to 2.

The comparative degree of nourishment which the grass of the *Festuca rubra* affords, exceeds therefore that afforded by the *F. ovina* in proportion as 11 to 14.

From the trial that is here detailed, it does not seem to possess the nutritive powers generally ascribed to it; it has the advantage of a fine foliage, and may, therefore, very probably be better adapted to the masticating organs of sheep than the larger grasses, whose nutritive powers are shewn to be greater: hence on situations where it naturally grows, and as pasture for sheep, it may be inferior to few others. It possesses natural characters very distinct from *F. rubra*.

17. *Dagtylis glomerata*.—Round-headed cock's-foot. Nat. of Britain.

	Weight of Grass.		Nutritive matter	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, 24th June, produce from a rich sandy loam, is	249	0 17—9	2	25

This grass gains 3 cwt. 0 qr. 26 lbs. by standing till the seed is ripe, 14th July, more than one-third part of its value.

The produce of the lattermath, is .. 106 1 10—2 2 10

The proportional value which the grass of the lattermath bears to that at the time of flowering, is as 6 to 10; and to that at the time the seed is ripe, as 6 to 14. 64 dr. of the straws at the time of flowering afford of nutritive matter, 1.2 dr. The leaves or lattermath, and the straws simply, are therefore of equal proportional value; a circumstance which will point out this grass to be more valuable for permanent pasture than for hay. The detailed circumstances point out the necessity of keeping this grass closely cropped, either with the sithe or cattle, to reap the full benefit of its great merits.

21. *Poa angustifolia*.—Narrow-leaved meadow-grass. Nat. of Britain.

	Weight of Grass		Nutritive matter.	
	Cwt.	qrs. lbs	Cwt	qrs lbs.
At the time of flowering, June 28th, the produce from a brown loam, is	153	1 12—12	3	2
At the time the seed is ripe, 16th of July, the produce per acre, is ..	85	0 8—	6 1	8

The weight of nutritive matter, which is lost by leaving the crop till the seed be ripe, (is very great,) nearly half its value, 6cwt. 2qrs. 6lbs.

In the early growth of the leaves of this species of *Poa*, there is a striking proof that early flowering in grasses is not always connected with the most abundant early produce of leaves. In this respect all the species which have already come under examination, are greatly inferior to that now spoken of. Before the middle of April the leaves attain to the length of more than twelve inches, and are soft and succulent; in May, however, when the flower-stalks make their appearance, it is subject to the disease termed *rust*, which affects the whole plant; the consequence of which is manifest in the great deficiency of produce in the crop at the time the seed is ripe, being one-half less than at the time of the flowering of the grass. Though this disease begins in the straws, the leaves suffer most from its effects, being at the time the seed is ripe completely dried up: the straws, therefore, constitute the principle part of the crop for mowing, and they contain more nutritive matter in proportion than the leaves. This grass is evidently most valuable for permanent pasture, for which, in consequence of its superior, rapid, and early growth, and the disease beginning at the straws, nature seems to have designed it. The grasses

which approach nearest to this in respect of early produce of leaves, are the *Poa fertilis*, *Dactylis glomerata*, *Phleum pratense*, *Avena eliator*, and *Bromus littoreus*, all grasses of a coarser kind.

22. *Avena eliator*. — Tall oat-grass. Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time the seed is ripe, July 16th,				
the produce is	144	3 11—2	1	3
The produce of the lattermath, is....	121	2 4—2	1	13

This grass sends forth flower-straws during the whole season : the lattermath contains nearly an equal number with the flowering crop. It is subject to the rust, but the disease does not make its appearance till after the period of flowering : it affects the whole plant, and at the time the seed is ripe, the leaves and straws are withered and dry. This accounts for the superior value of the lattermath over the seed crop, and points out the propriety of taking the crop when the grass is in flower.

23. *Poa eliator*. — Tall meadow-grass. Nat. of Scotland.

At the time of flowering, 28th June,
from a rich clayey loam, is 109 1 15—5 ' 3 26

The botanical characters of this grass are almost the same as those of the *Avena eliator*, differing in the want of the awns only. It has the essential character of the *Holci*, (Florets male, and hermaphrodite : Calyx husks two-valved, with two florets,) and since the *Avena eliator* is now referred to that genus, this may with certainty be considered a variety of it. We find here a much greater weight of the nutritive matter, in a less bulk of grass, than in the *Avena eliator*.

24. *Festuca duriuscula*.—Hard fescue-grass.
Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, July 1st, the produce from a light sandy loam, is	164	0	8—8	3 24
The lattermath, is	91	0	8—1	3 3

The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 6 to 14, nearly.

The proportional value which the grass of the lattermath bears to that at the time of flowering, is as 5 to 14, and to that at the time the seed is ripe, 5 to 6.

The above particulars will confirm the favourable opinion which was given of this grass when speaking of the *Festuca hordiformis*, and *F. glabra*. Its produce in the spring is not very great, but of the finest quality, and at the time of flowering is considerable. If it be compared with those affecting similar soils, such as *Poa pratensis*, *Festuca ovina*, &c. either considered as a grass for hay, or permanent pasture, it will be found of greater value.

27. *Festuca pratensis*.—Meadow fescue-grass.
Nat. of Britain.

At the time of flowering, July 1st, the produce from a bog-soil, with coal-ashes for manure, is	121	1	22—8	2 25
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The value of the grass at the time the seed is ripe, is to that of the grass at the time of flowering, as 6 to 18.

The loss which is sustained by leaving the crop of this grass till the seed be ripe is very great. That it loses more of its weight in drying at this stage of growth, than at the time of flowering, perfectly agrees with the deficiency of nutritive matter in the seed crop, in pro-

portion to that in the flowering crop: the straws being succulent in the former, they constitute the greatest part of the weight; but in the latter, they are comparatively withered and dry, consequently the leaves constitute the greatest part of the weight. It may be observed here, that there is a great difference between straws or leaves that have been dried after they were cut in a succulent state, and those which are dried (if I may so express it) by nature while growing. The former retain all their nutritive powers; but the latter, if completely dry, very little, if any.

28. *Lolium Perenne*.—Perennial rye-grass. Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, July 1st, the produce per acre, is.....	62	3 15	2	2 25
At the time the seed is ripe, July 20th, the produce per acre, is.....	133	2 21	5	2 27

The weight of nutritive matter which is lost by taking the crop at the time of flowering, is nearly one half of its value.

The produce of the lattermath, is 30 1 15—0 1 25

The proportional value which the grass of the lattermath bears to that at the time of flowering, is as 4 to 10, and to that at the time the seed is ripe, as 4 to 11.

33. *Festuca loliacea*.—Spiked fescue-grass. Nat. of Britain.

The produce per acre at the time of flowering, July 1st, from a brown rich loam, is	145	3 9	6	3 9
At the time the seed is ripe, 28th July, is	26	0 26	4	3 21
The produce of the lattermath, is....	30	1 15	0	2 10

The proportional value which the grass, at the time of flowering, bears to that at the time the seed is

ripe, is as 12 to 13; and the value of the latter math stands in proportion to that of the crop at the time of flowering, as 5 to 12, and to that of the crop taken at the time the seed is ripe, as 5 to 13.

This species of fescue greatly resembles the rye-grass, in habit and place of growth: it has excellencies which make it greatly superior to that grass, for the purposes of either hay or permanent pasture. This species seems to improve in produce in proportion to its age, which is directly the reverse of the *Lolium perenne*, or common rye-grass.

38. *Festuca calamaria*.—Reed-like fescue-grass. Nat of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt. qrs. lbs.		Cwt. qrs. lbs.	
At the time of flowering, July 10th, the produce from a clayey loam, is ..	486	0 18—34	0	20
At the time the seed is ripe, July 28th, the produce, is	456	3 2—21	1	2

The weight of nutritive matter which is lost by leaving the crop till the seed is ripe, being nearly one-third part of its value.

The proportional value which the grass, at the time the seed is ripe, bears to that at the time of flowering, is as 12 to 18.

This grass, as has already been remarked, produces a fine early foliage in the spring. The produce is very great and its nutritive powers are considerable. It appears, from the above particulars, to be best adapted for hay. A very singular disease attacks, and sometimes nearly destroys the seed of this grass: the cause of this disease seems to be unknown; it is denominated *clavus* by some; it appears by the seed swelling to three times its usual size in length and thickness, and

the want of the carcle. Dr. Willdenow describes two distinct species of it; 1st, the simple clavus, which is mealy and of a dark colour, without any smell or taste; 2dly, the malignant clavus, which is violet blue, or blackish, and internally too has a blueish colour, a foetid smell, and a sharp pungent taste. Bread made from grain affected with this last species, is of a blueish colour; when eaten, produces cramps and giddiness.

39. *Bromus littoreus*.—Sea-side broom-grass. Nat. of Germany: grows on the banks of the Danube and other rivers.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, July 12th, the produce from a clayey loam, is ..	370	2 22—	8	3 21
At the time the seed is ripe, 6th Aug.,	340	1 7—	18	2 12

The weight of nutritive matter lost by taking the crop at the time of flowering, exceeding one-half of its value, 9 cwt. 3 qrs. 19 lbs.

This species greatly resembles the preceding, in habit and manner of growth, but is inferior to it in value, which is evident from the deficiency of its produce, and of the nutritive matter afforded from it. The whole plant is likewise coarser, and of greater bulk in proportion to its weight. The seed is affected with the same disease which destroys that of the former species.

40. *Festuca eliator*.—Tall fescue-grass. Nat. of Britain.

At the time of flowering, July 12th, the produce from a black rich loam, per acre, is	455	3	2—35	2	12
At the time the seed is ripe, August 6th, the produce is	455	3	2—21	1	12
The produce of lattermath, is	139	3	2—	8	2 26

The proportional value which the grass of the lattermath bears to that of the crop, is as 16 to 20; and to that at the time the seed is ripe, as 12 to 16 inverse.

This species of fescue, is closely allied to the *Festuca pratensis*, from which it differs in little, except that it is larger in every respect. The produce is nearly three times that of the *F. pratensis*, and the nutritive powers of the grass are superior, in direct proportion, as 6 to 8.

43. *Festuca fluitans*. — Floating fescue-grass. Nat. of Britain.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, July 14th, the produce from a strong tenacious clay, per acre, is	12	1 22	— 3	1 8

The above produce was taken from grass that had occupied the ground for four years, during which time it had increased every year; it therefore appears contrary to what some have supposed, to be capable of being cultivated in perennial pastures.

44. *Holcus lanatus*. — Meadow soft-grass. Yorkshire grass. Nat. of Britain.

At the time of flowering, July 14th, the produce from a strong clayey loam, is	170	0 17	— 10	2 15
At the time the seed is ripe, July 26th,	170	0 17	— 7	1 6

The proportional value which the grass at the time the seed is ripe, bears to that at the time of flowering, is as 11 to 12.

It may be proper here to mention that these references are taken from the grass in a dry state, and some of them lose more in drying from the seed crop, than others from the flowering crop, which will account for

the proportional value not exactly agreeing with the two comparisons, as above and before stated.

46. *Poa fertilis*.—Fertile meadow-grass. Nat. of Germany.

	Weight of Grass.		Nutritive matter.	
	Cwt.	qrs. lbs.	Cwt.	qrs. lbs.
At the time of flowering, July 14th, the produce from a clayey loam, is..	133	2 21—	9	1 16

If the nutritive powers and produce of this species be compared with any other of the same family, or such as resemble it in habit and the soil which it affects, a superiority will be found, which ranks this as one of the most valuable grasses; next to the *Poa angustifolia*, it produces the greatest abundance of early foliage, of the best quality, which fully compensates for the comparative lateness of flowering.

47. *Arundo colorata*.—Striped-leaved reed-grass. Nat. of Britain.

At the time of flowering, 16th July, the produce from a black sandy loam, is	243	0	9—15	0	21
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The strong nutritive powers which this grass possesses recommend it to the notice of occupiers of strong clayey lands, which cannot be drained. Its produce is great, and the foliage will not be denominated coarse, if compared with those which afford a produce equal in quantity.

48. *Trifolium pratense*.—Broad-leaved cultivated clover. Nat. of Britain.

At the time the seed is ripe, 30th July, the produce from a rich clayey loam, is	437	2	5—17	0	10
Weight when dry,	109	1	15		

The weight lost by the produce of one acre, in drying,	328	0	18
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If the weight which is lost by the produce of this species of clover, in drying, be compared with that of many of the natural grasses, its inferior value for the purpose of hay, compared to its value for green food, or pasture, will appear; for it is certain that the difficulty of making good hay increases in proportion with the quantity of superfluous moisture which the grass may contain. Its value for green food, or pasture, may further be seen by comparing its nutritive powers, with those manifested by other plants generally esteemed best for this purpose.

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PAGE	LINE
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ERRATA.

95	— 3—	for <i>old</i> pastures read <i>young</i> pastures.
98	— 11—	for 26s read 30s.
111	— 6—	should read <i>of great importance at all times.</i>
134	— 28—	for <i>permeable</i> read <i>impervious.</i>
242	— 26—	should read <i>takes up Gypsum as well as Clover</i>
<i>from the soil.</i>
255	—	bottom line read <i>county</i> for <i>country.</i>
256	— 14—	read—in <i>nearly</i> as quick a time.
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