









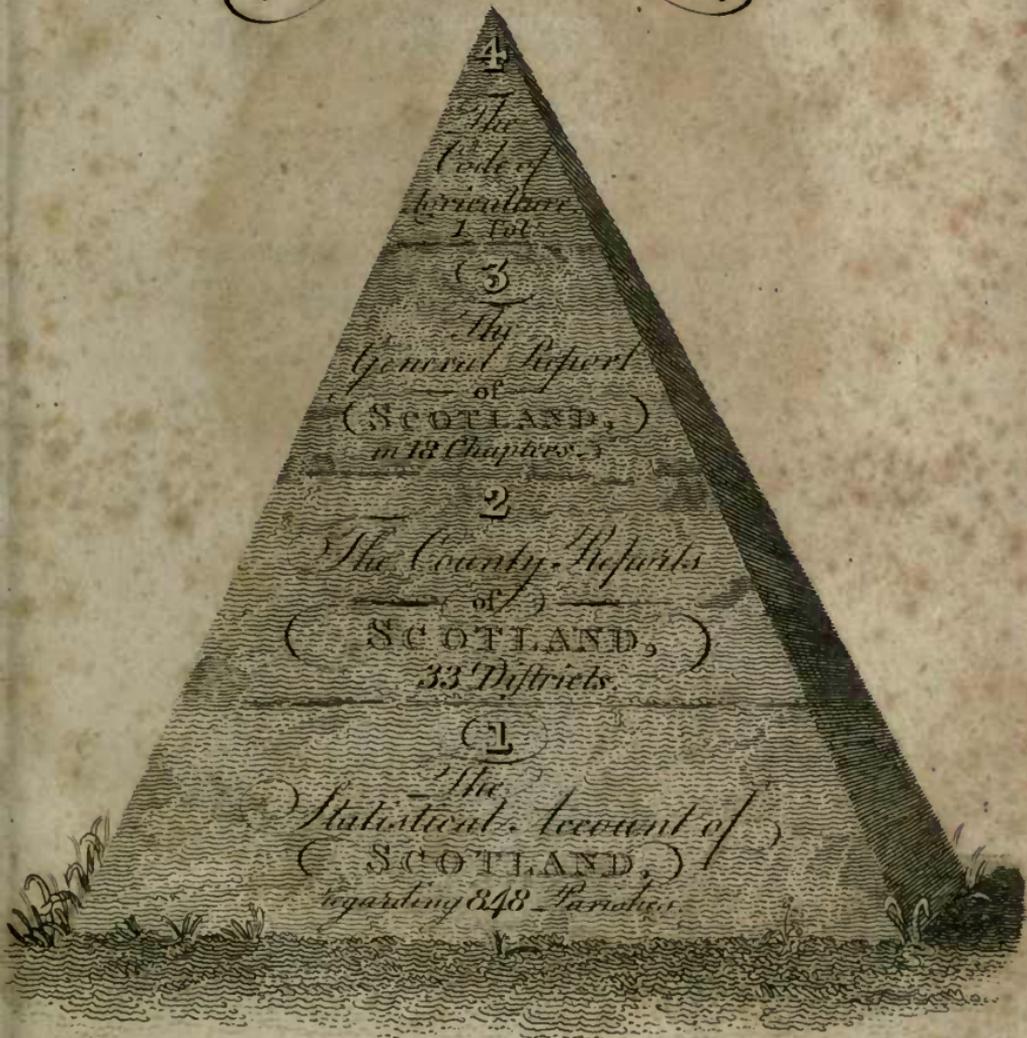




*The Right Honourable*  
**SIR JOHN SINCLAIR of ULBSTER**  
*President of the Board of Agriculture*

— Lr Lr Lr —

*The Pyramid*  
OF  
STATISTICAL INQUIRY.



The ultimate object of the extensive inquiries which have been so long carried on, was, to draw up "a Code of Agriculture". To render such a work however, as Perfect as it ought to be, a broad Basis was necessary; Hence originated 1. The Statistical account of Scotland. 2. The County Reports, and 3. The General Report of Scotland. A General Report of England is alone wanting to complete the whole Undertaking.



AN  
ACCOUNT  
OF THE  
SYSTEMS OF HUSBANDRY  
ADOPTED IN  
THE MORE IMPROVED DISTRICTS  
OF  
SCOTLAND;

WITH  
SOME OBSERVATIONS ON THE IMPROVEMENTS OF  
WHICH THEY ARE SUSCEPTIBLE.

DRAWN UP FOR THE CONSIDERATION OF THE BOARD OF AGRICULTURE,  
WITH A VIEW OF EXPLAINING HOW FAR THOSE SYSTEMS ARE  
APPLICABLE TO THE LESS CULTIVATED PARTS IN  
ENGLAND, AND SCOTLAND.

---

BY THE RIGHT HONOURABLE  
SIR JOHN SINCLAIR, BART.  
PRESIDENT OF THE BOARD OF AGRICULTURE.

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*The Second Edition.*

IN TWO VOLUMES.

VOL. I.

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“*Knowledge is power.*” BACON.

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EDINBURGH:

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JOHN CUMING, DUBLIN.

1813.

## ACCOUNT

OF THE

## SYSTEMS OF HUSBANDRY

ADAPTED BY

THE MORE IMPROVED DISTRICTS

OF

SCOTLAND:

WITH

SOME OBSERVATIONS ON THE IMPROVEMENT OF

WHICH THEY ARE DIRECTED.

BY THE AUTHOR OF THE "ARTS AND MYSTERY OF THE  
 HUSBANDRY OF THE SCOTCH PEASANTS," AND  
 WITH A VIEW TO THE IMPROVEMENT OF THE  
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Printed by James Ballantyne & Co.  
 10, N. B. Street, Edinburgh.  
 1813.

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## ADVERTISEMENT

TO THE

FIRST EDITION.

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I HAVE at length the satisfaction of laying before the Public, an Account of the Systems of Husbandry adopted in the more improved districts of Scotland. It was drawn up at the request of a most respectable friend, (Sir Joseph Banks), who thought, that such an investigation would be productive of beneficial consequences to the agricultural interests of the united kingdom ; and he urged, that it was incumbent upon a native of Scotland, while presiding at the Board of Agriculture, and possessing all the means of information which that situation afforded, to undertake the task. Being occupied with many other avocations, nothing but the respect which I entertain for the opinion of so zealous a friend to improvement,

could have induced me to engage in so arduous an attempt. Indeed, the labour and difficulties attending it, have gone far beyond every idea I could have formed of them. To execute the task in a satisfactory manner, it seemed to me necessary, personally to examine several of the more improved districts in Scotland, to converse with the farmers in their own fields, to explain to them distinctly, not only the general objects I had in view, but also the particular facts I wished to ascertain; and to obtain from them, not hasty answers, to questions suddenly put, but details, maturely considered, and carefully drawn up. The reader has now an opportunity of examining the result of the whole investigation. The Author claims the merit only of collecting, condensing, and digesting, the important information which was most liberally furnished. The credit of *the knowledge* which this Work may contain, belongs entirely to the intelligent and public-spirited Farmers from whom that information has been derived.

I trust that there are several observations contained in this Work, which will prove of service in those districts of England, where the cultiva-

tion of arable land, owing to the attention of the farmer having been principally directed to the management of grass land, to the profits of the dairy, and to the breeding of stock, has hitherto been but a secondary object. At the same time, it has been my wish, to make this Treatise useful also to the farmers of Scotland; and for that purpose, I have incorporated a variety of hints, which attention to English Husbandry, and the communications of many respectable correspondents in the southern part of the united kingdom, have enabled me to suggest.

I cannot submit this work to the consideration of the Public, without congratulating my country, on the anxious desire to obtain agricultural knowledge, which now so universally prevails in every part of the united kingdom. Indeed, when I consider that zeal for improvement, and that thirst for useful information, by which the British Isles are, at this time so peculiarly distinguished, I cannot entertain a doubt, that Agriculture will soon reach a degree of excellence in this country, which it has never hitherto attained in any other; and that the merit of discovering the most effectual means, “*of providing food for man,*” the first

of all political objects, will, in future ages, be attributed, to the skill, the spirit, and the enterprise of British Farmers.

JOHN SINCLAIR.

CHARLOTTE SQUARE, EDINBURGH, }  
24th February, 1812.

# ADVERTISEMENT

TO THE

SECOND EDITION.

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FROM the anxiety to obtain Agricultural information, another Edition of the Husbandry of Scotland has become necessary. In preparing it for the press, every endeavour has been made to render it as correct as possible, and to explain several particulars which had not been sufficiently discussed in the former impression. The Author more especially alludes to the subject of *Straw*, the importance of which cannot be too highly estimated, but which had not been treated of at much length, either in the First Edition of this Work, or in any former Publication.

CHARLOTTE SQUARE, EDINBURGH, }  
15th July, 1813. }

ADVERTISEMENT

SECOND EDITION

From the anxiety to obtain Agricultural improve-  
ment another Edition of the Husbandry of Great  
Britain has become necessary. In preparing it for  
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that it is as correct as possible, and to explain every  
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CHARLES BARNES, Printer,  
1787.

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AN ACCOUNT  
OF THE  
HUSBANDRY OF SCOTLAND,  
MORE ESPECIALLY AS PRACTISED  
IN  
ITS BEST CULTIVATED DISTRICTS.

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INTRODUCTION.

*Of the various circumstances which have contributed to the excellence of Scottish Husbandry, and an explanation of the Plan of the Work.*

**BEFORE** giving any explanation of the plan proposed to be adopted in drawing up the following work, it may not be improper, briefly to point out those causes, which have principally contributed to the excellence of Scottish Husbandry, as practised in its more improved districts, several of which, however, are not to be considered as solely applicable to the northern part of the kingdom.

1. Though the climate of Scotland is in general rather unfavourable to cultivation, (a disadvantage which the Scotch farmers have assiduously, and often successfully endeavoured to counteract) yet the country, on the whole,

enjoys several natural advantages of considerable importance. Its maritime situation, and its numerous bays and arms of the sea, together with the lakes and streams with which it is so amply provided, not only tend to promote its commerce, but are also favourable to its agriculture. It is also largely furnished with those essential requisites for improvement, limestone and marle; and it possesses, in most of its districts, that most important article, fuel, in considerable quantities.

2. Owing to the establishment of parochial schools, the farmers of Scotland had, in general, all the advantages of a good education, and having thence acquired a taste for reading, became not only fond of perusing works on agriculture, but were anxious to avail themselves of any information they might thus obtain. Hence the culture of artificial grasses, and the best mode of applying them by means of soiling, with various other useful practices, spread rapidly over the whole country. Numbers of Scotch farmers, also, were accustomed to travel, with a view of acquiring useful information, and of comparing their own practices with those of other districts.\*

3. Many of the proprietors of land in Scotland, who were distinguished by the acquisition of useful, rather than of showy accomplishments, took a delight in rural occupations; and, in various districts, now under a complete system of husbandry, they either improved their estates them-

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\* An intelligent farmer once remarked to me, that he derived more advantage, by travelling about to see the improvements of others, than by attempting to make discoveries of his own. Almost every Scotch farmer has travelled through his own county, and some of the neighbouring ones; many have visited England, and some have even penetrated into Flanders, for the express purpose of obtaining agricultural information.

selves, or encouraged their tenants to exertion, establishing for that purpose a most liberal system of connexion between the two classes.

4. It became a custom in Scotland, at an early period, to grant leases for an adequate term of years, without the possession of which, no material improvement, *on the part of the tenant*, can possibly be expected; and to that circumstance, perhaps more than to any other, is the excellence of Scottish husbandry to be attributed. Indeed, *extensive* improvements have not taken place in any part of England, but where the same custom has prevailed. In regard to the granting of leases, nothing can be more ill judged, than for a landlord, both to neglect his immediate interests, and to prevent the future improvement of his estate, in order to procure a little political influence, which a generous proprietor can always command, when he may have occasion for it, without keeping his tenants in a state of slavish dependence.

5. In many parts of England, where estates are possessed by tenants for life, or under the fetters of a trust, it is questionable, whether leases of a considerable endurance can be granted, or whether old pastures, though in extent beyond any real advantage to the estate, can be broken up; whereas in Scotland, even when land is under a perpetual and strict entail, leases may be granted for thirty-one years, and upwards, without any unnecessary restrictions against arable cultivation, and the tenant is enabled to do every thing that the proprietor could have done himself, had he retained possession of the land.\*

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\* The act 10. Geo. III, c. 51, A. D. 1770, introduced by the late Sir James Montgomery, is favourable to the improvement of entailed property. By that statute it is enacted, that every proprietor of an entailed estate, who shall lay out money in inclosing, planting, draining, or

6. The inferior capitals of the Scotch farmers, when their improved system of husbandry commenced, rendered it necessary for them, to study economy in the management of their farms, to cultivate their lands with fewer horses, with cheaper implements, and with a smaller number of servants; and hence originated a system of management, distinguished by two important advantages, *economy* and *simplicity*.

7. In the more improved districts of Scotland, the farms are in general of a proper size for arable culture. Small lots are beneath the attention of an opulent and intelligent farmer. Much time is lost in the cultivation of small farms, and the comparative expence is much greater, where the servants and cattle have not constant occupation; whereas, with a farm of a proper size, (the extent of which will be the subject of future discussion †) every hour may be advantageously employed.

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in erecting farm-houses and offices for the same, shall be a creditor to the succeeding heirs of entail, for three-fourths of the money laid out, provided that the amount claimed, shall not exceed four years' free rent of the estate, at the first term of Whitsunday, after the demise of the heir who expended the money. The expence of building or repairing the mansion-house or offices, becomes also a debt against the heir of entail, to the amount of three-fourths of the money expended, if the claim does not exceed two years' free rent. It may, however, be necessary to observe, that certain formalities are required to be attended to, in expending the money, and constituting it a debt against the heirs of entail. By this statute, which is entitled, an act "for encouraging the Improvement of Land in Scotland, held under Settlements of strict Entail," it is lawful for the proprietor, to let leases for 31 years, or for 14 years and one existing life, or for two existing lives, under certain conditions as to inclosing, if let for longer than 19 years; and proprietors may let building leases, of not more than five acres extent, under certain conditions, for any period not exceeding 99 years.

† See Dissertation I, Part II, On the Size of Farms.

8. Soon after improvements began, the rents of lands were progressively increased, without the spur of which, neither industry in cultivation, nor economy in management, can in general be expected. Oppressive and sudden additions ought certainly to be avoided; but without a fair income for his land, no proprietor ought to part with a control over his estate, more especially for so long a period as nineteen or thirty-one years. A tenant, on the other hand, who obtains a lease of some duration, and on liberal terms in regard to covenants, can well afford a reasonable augmentation, either at once, or at different periods of his lease, on a rent that was previously moderate.

9. It was a circumstance peculiarly favourable to the improvement of Scotland, that the farmers, in general, were liable to no material burden, but their rent to the landlord, by whom the land-tax, and, since the year 1633, the stipend to the clergyman have been usually paid.\* Wherever there is any uncertainty in regard to the sums to be exacted, (more especially if the burden increases with the industry exerted) no farmer will attempt any expensive improvement. Hence one of the advantages of a recent law, by which the servitude of *thirlage*, or bondage to any particular mill, may be legally commuted. The personal services also, to which the Scotch peasantry were, at one time, subjected, and which were often indefinite, are now almost entirely exploded.

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\* One-half of the parochial schoolmaster's salary is paid by the tenantry, together with one-half of the expence of maintaining the poor. This, however, is a trifling object, as the expence of supporting the poor is chiefly defrayed by voluntary collections at church on Sundays. The Scotch farmers are also liable in payment of the property-tax, and either to statute labour, or road assessments.

10. A considerable proportion of the most fertile land in England, until bills of division and inclosure were introduced, (which have in some degree alleviated the evil, though not to the extent that could be wished for) was actually debarred from improvement, by the common-field system; whereas in the more improved districts of Scotland, owing to a general Bill of Inclosure passed by the Scotch Parliament in 1695, every farm, for many years past, has been a distinct possession, or been held in severalty.

11. The expence of labour in Scotland, does not differ materially from that of several extensive districts in England; and the day-labourers in that country, certainly execute as much work, within the same period of time, as those in Scotland; *but the servants employed in husbandry* in Scotland, are in general more tractable, are satisfied with homelier fare, have fewer perquisites, are less accustomed to waste their time and their wages unprofitably, are generally married, and thence steadier in their conduct, are more regular and constant in their hours of labour, and having commonly received a better education, are thence less addicted to debauchery, or to any irregularity of conduct.

12. In Scotland, the laws are favourable to cultivation and improvement, a circumstance to which the excellence of the Scotch husbandry is greatly to be attributed. Regulations exist, which facilitate the division of commons and of common fields; fences erected between two distinct estates, are made at the joint expence of the owners; the value of the tithes of any estate, can be fixed by the decision of the supreme court of justice, and when once fixed by a legal valuation, and converted into what may be called *a corn rent*, the amount cannot afterwards be increased: The possessor of any estate can, in general, exonerate his

property from all indefinite demands upon it, of a feudal nature; leases are interpreted, by the courts of law, favourably to the tenant; and the occupiers of land, in general, are not subjected to any arbitrary burdens, under the name of Poor-rates.\*

13. The establishment of banks, and the extension of paper money, have certainly materially contributed to the improvement of Scotland.† Enterprising farmers have thus been supplied, when necessary, with aid to carry on their operations, and have obtained a better price, and a readier payment, for their commodities;—no small inducements to exertion. Where the public banks, or their branches, also, are established, the savings of the prudent and economical farmer, have not only been safely deposited, and borne an interest of from 3 to 4 *per cent.*, but were always ready at his command.

14. In the last place, the character of the Scots, industrious, economical, intelligent, and persevering, and their habits of life, calculated to maintain that national character, would naturally enable them to reach a considerable degree of excellence, in any art or science, to which their attention might be peculiarly directed.

Other causes, as will appear in the course of the following investigation, may have also indirectly contributed to the improved state of Scotch Husbandry; but the circumstances above detailed, will, it is believed, sufficiently ex-

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\* I say *in general*, for there are exceptions to this rule in several of the southern counties.

† The celebrated Sir James Steuart, in his *Political Economy*, (last edit. vol. iii, p. 197) says, “To the banks of Scotland the improvement of that country is *entirely owing*.” Without going so far, it may be safely asserted, that to the improvement of Scotland they have *materially contributed*.

plain, why that system should have reached a considerable degree of perfection, and may, in various respects, be accounted a pattern for other districts, similarly situated, in so far as regards *arable cultivation*.

We shall next proceed, to explain the nature of the plan intended to be adopted, in the prosecution of this important enquiry. It is proposed to divide the Work into Two Parts.

## PART I.

This Part will be purely practical, explaining, *first*, the best practices of the most distinguished Scotch farmers, regarding those points which require attention, previous to the commencement of arable culture; and, *secondly*, those particulars, which are connected with the actual cultivation of an arable farm, and the most profitable means of maintaining its stock. This part of the work will be concluded with, 1. A general view of the improved Systems of Husbandry adopted in Scotland; 2. An account of the improvements of which those systems are susceptible; and, 3. Some observations on the means by which the useful practices of the best Scotch farmers, may be most advantageously disseminated throughout the less improved districts of England and Scotland; together with a general view, of the public and private advantages which may be derived from their more general adoption.

## PART II.

There are some questions, however, connected with the husbandry of Scotland, and with the improvement of that country, which are rather of a more abstruse nature, the

explanation of which requires a good deal of research, and much reflection thoroughly to comprehend; in particular, 1. The size of farms; 2. The means by which a liberal system of connexion can be established between the landlord and tenant; and, 3. The characters of those who are employed in agricultural labour, in the more improved districts of Scotland. These are points, which it is thought more advisable to place in a distinct division of the work, and to discuss in separate dissertations.

In an Appendix, some information will be given, connected with the improvement of Waste Lands in Scotland, (a subject to which the public attention cannot be too frequently called) and some other particulars, respecting which the author trusted, that the information he had to communicate, would be acceptable to the public.



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# PART I.

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## CHAPTER I.

ON THE POINTS WHICH REQUIRE ATTENTION, PREVIOUS TO  
THE COMMENCEMENT OF ARABLE CULTURE.

**BEFORE** a farmer commences the actual cultivation of an arable farm, there are several particulars which will require his attention, as, 1. The position of the Farm-House and Offices; 2. Their Construction; 3. The size of the Fields; 4. The mode of Fencing; 5. The Draining necessary; 6. The Roads on the Farm; 7. The Instruments of Husbandry; 8. The Live Stock; and, 9. The Soil, the elevation and exposure, the climate, and the situation of the farm in regard to markets.

It is proposed to discuss each of these points, as briefly as their importance will admit of, in separate sections.

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### SECT. I.—*Position of the Farm-House and Offices.*

THE first point that any judicious farmer would resolve to ascertain, in regard to any farm he would wish to oc-

cupy, (more especially if it were of considerable extent, namely, from 300 to 500, or 1000 acres) would be, whether the farm-house and offices were properly situated, and erected as nearly as possible in the centre of the farm. In many cases this would make a difference in point of rent, of from 1s. to even 5s. *per acre*, according to the size of the farm, and various local circumstances therewith connected. The difference is calculated, by some intelligent farmers, at the expence of a plough, or L.100, and on very extensive farms at nearly L.200 *per annum*.\* If the house and offices are placed in the corner of a large farm, a part of the land will often be neglected by the farmer; less manure will be sent to it; the expence of cultivation is materially increased; the strength of the horses uselessly wasted in going backwards and forwards, instead of being employed in profitable labour; whilst the remote part of the farm is left, in what in Scotland is called an *outfield* or *afterwall* state, that is to say, in miserable pasturage occasionally broken up.

In the improved districts of Scotland, this is a point as much attended to as the circumstances of the case admit of, more especially when any new buildings are constructed.†

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\* Mr Walker of Mellendean states, that the old farm-buildings on his farm of Rutherford, before he got possession of it, were placed on the very extremities of the ground, and the acclivity from them being considerable, the upper part of the land of course got a very small share (if any) of the manure. The principal buildings are now nearly central, for 800 acres, and another set of offices equally so for the remainder; by which means the corn is carried a much shorter distance to the barn-yard, and the dung to the fields at much less expence. These, and other conveniences, he calculates are equal to a saving of nearly L.200 *per annum*.

† It is remarked by an intelligent correspondent, that the farm-buildings in the more improved districts of Scotland, are in general much more convenient than those to be met in almost any other country; and that

How different from that state of feudal barbarism, (which may still be found in some districts in England) where all the farm-houses of a parish were collected into a village, originally for the sake of mutual protection and defence, and where all the neighbouring fields were cultivated in common. In such cases, one yoking a-day, is frequently the plan adopted for working the servants and horses, to which, in consequence of the distance of the fields from the residence of the farmer, the name of *journey* is most emphatically and properly given.

There can only be one reason for not having the farm-house and offices in a central situation, and that is, when a better command of water, for family use, for the farm stock, or for driving a threshing-mill, can be had else-where. Sometimes, also, wind cannot be commanded in the centre for the use of a threshing-mill, by which a great saving in the labour of horses might be obtained. These, however, are only exceptions to the general rule; for it may be laid down as an axiom in agriculture, “*That the farm-house and offices ought to be placed, as nearly as possible, in the centre of a farm.*”

Where the circumstances of the case will admit of it, the farm-house and offices should front the south, should be sheltered from piercing winds, and the fold-yard should enjoy the benefit of the morning sun in winter. The farm-stead should be placed *on an elevated situation*. It is not only healthier for the farmer, his family, and his servants, but carts will bring home the corn in harvest time, with least waste, when going up hill, and when empty, they can return to the harvest field, in very urgent cases, with a quicker step, which will much expedite the getting home and securing

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in a large farm, there is the difference of at least the labour of one man throughout the year, between a convenient and inconvenient set of offices.

the farm produce. The manure from the farm-yard so situated, will all be conveyed down-hill to the fields, in the cheapest and most expeditious manner.\*

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SECT. II.—*The best Construction of a Farm-House and Offices.*

THIS is a most material point for the consideration both of the farmer and of the landlord, and the rent to be paid, ought certainly in some measure to depend, on the goodness of the accommodations with which the occupier is provided.† With convenient offices, it is evident, that the grain produced on the farm, can be better preserved, and more advantageously separated from the straw, and prepared for market. The live-stock also on the farm, can be more easily and regularly fed; and being thus kept in better order, must consequently be fitter for their work, or for the market. The propriety and advantage likewise of having suitable accommodations for the farmer, his family and his servants, need not be dwelt upon. The expence of erecting such buildings must be considerable when first laid out, but no liberal landlord, who has the sum requisite at his com-

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\* Remark by an intelligent correspondent. It may also be observed, that when the house is built on an elevated situation, the farmer will have it in his power to see what is going on all around him.

† Even *minutia* may be of great consequence to a tenant; for instance, in the erection of barns, more especially if the walls are rough, it is of importance to have a projecting stone or brick at every aperture for the

mand, will grudge to lay it out for the comfort and benefit of an industrious tenant, who pays an adequate rent. Every convenience afforded to the farmer, for enabling him to carry on his business with as little expence, and to as much advantage as possible, must indeed greatly enhance the value of the farm, and will insure to the landlord, should he have occasion to seek for a new tenant, abundance of competitors for a situation in these respects so eligible.

Where convenience and utility are the objects principally attended to, it is recommended by an intelligent agriculturist in Roxburghshire, who has had great experience in the erecting of such buildings, (Mr Walker of Wooden) to have the farm-house of three stories, the kitchen-story half sunk. This makes the house itself drier, as it is necessary to take such peculiar precautions against dampness in the foundation, and less roofing will furnish the farmer with the accommodations he may require. He adds, that he has made plans of farm-houses, both of that construction, and with only two stories, having the kitchen and dairy behind; but he knows that the house of three stories gives most satisfaction to the occupier. Others object to this plan, maintaining, that though a half-sunk story may tend to make the upper floor drier, yet that it is very apt to be damp itself; that it likewise gives much more trouble to the mistress of the house in superintendance; and that the noise from the kitchen is often disagreeable, more especially when a number of servants assemble toge-

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admission of air, to prevent the access of vermin; and in laying the foundation of barns, that material object, the exclusion of vermin, ought always to be kept in view. If the foundation stones were regularly cut like bricks, and jointed, it would prevent the possibility of vermin getting in at that part of the building. But where it is the custom to have barns, with floors of board, into which loaded waggons are admitted, the exclusion of vermin is impossible.

ther in the evening. Hence a double house of two stories, with a back jamb, (or lean-to, as it is called in England) and wings attached to the house, is preferred by many farmers.\*

In regard to the expence of erecting new farm-steads, it cannot be properly estimated, as the price of building, and the expence of materials, vary in every district. In some publications it is stated at from two and a half to three years' rent of the farm. It is evident, that this can only refer to farms of a small size. In larger occupations, when the landlord receives a considerable rent, the allowance must be higher.

As to farm-houses and offices, the following princi-

\* Opinions vary much regarding the proper construction of farm-offices. Mr Stewart of Hillhead is of opinion, that farmers who occupy from 200 to 300 acres, or who have capitals from £1000 to £2000, ought to be satisfied with a double house of one story, with garrets for various apartments; which will afford convenient accommodation at a moderate expence. Captain Henderson of Aimster, in Caithness, on the other hand, recommends a lean-to, back-jamb, or to-fall, as it is called in some parts of Scotland, which furnishes as much accommodation, in the two lower flats, as a double house, and at less expence. But Mr Wight of Ormiston greatly prefers Mr Walker's plan of three stories, as better than a house with a wing and back-jamb, which is neither so neat nor handsome, besides requiring a greater extent of building and roofing in the first erection, and a greater extent of roofing to keep up ever after. In the half-sunk story, dampness can certainly be excluded, and the noise of the kitchen can also be shut out, either by proper deafening, or by removing the kitchen to that end of the house least occupied by the family. Mr Walker of Mellendean is decidedly of opinion, that in a dry situation, the same conveniences can be had at a much less expence, in a house with a sunk story, than in one with wings, and he has accordingly erected of that construction one on his farm at Rutherford.

ples ought to be kept in view, when such buildings are to be erected.

1. The house and offices should be on a scale proportionate to the size and produce of the farm, having utility, and not ornament, principally in view; though, at the same time, every landlord of taste, in fixing on the site and plan of a new farm-house and offices, will certainly not totally overlook the embellishment of the country. Not only the original cost, but the very expence of keeping unnecessary buildings in repair, is a heavy burden upon any property, which it is for the interest both of the landlord and of the tenant to avoid. The house and offices should afford ample convenience to the farmer in carrying on his business. On the other hand, all superfluous buildings, and useless decorations, ought to be avoided; for, as Dr Coventry has well observed, durable economy should be preferred to shifting taste.\* Nothing can be more absurd, than the enormous barns usually attached to all the great farms in England. Grain in the straw, keeps infinitely better in the open air, than in close barns; it is less apt to be destroyed by vermin, and saves the enormous expence of constructing and repairing great barns. Threshing-mills, when generally introduced, will soon prove the absurdity of erecting such unnecessary buildings.

2. The accommodations necessary for preparing the grain for market ought never to be too scrimp. The threshing-barn, for instance, must be sufficiently spacious to contain one stack of grain in the straw, in case of an unfavourable season. In good weather, it is the common practice to take in the corn when it is threshed, in which case no more room is necessary than to hold the machinery, and the peo-

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\* See Discourses on Agriculture, p. 5.

ple employed to manage it. The straw-barn, as recommended by Mr Walker of Wooden, should be so large as to pile up the straw of two stacks when threshed, so that a considerable quantity of straw may always be kept in good order for fodder. Indeed, the straw-barn ought to be so contrived, as to keep different kinds of straw separate, at least separately accessible, for fodder, and for litter, as bean or pease haulm, the straw of white corn, &c. Where cattle are fed on straw, (which it would be better to dispense with, if richer food, as will afterwards be explained, could be provided for them) the farmer would otherwise be obliged to thresh more frequently than he would wish to do. There ought to be a granary adjacent to the barn, in which the grain, when threshed, may be put, the lower part of which will furnish space for a cart-shed, which ought to be large enough to hold two carts for every plough. Others recommend, that the granary should be placed under the roof of the barn itself, by the addition of another floor, into which the grain, when dressed, may be conveyed by "hoisting tackle," driven either by the threshing-mill, or by hand, from the ground-floor.\*

3. In regard to the size of the stables, cow-houses, and feeding-sheds, much must depend on the manner in which the farm is occupied; as to the feeding-sheds, in particular, whether it is most advantageous to rear young cattle for the grazier, or to fatten older stock for the butcher; but it is a rule that ought never to be departed from, not to stint them in point of space, but to give the stock ample accommodation.† Where horses are kept in stalls, Mr

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\* Farmer's Magazine for June 1812, p. 225.

† Mr Shirreff's observations upon this subject are well entitled to attention. He thinks that all horses so heavy and large that two are

Brown of Markle is of opinion, that five feet of room in breadth is required, to give each horse comfortable accommodation, and that the stable ought not to be less than

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capable of drawing a plough, ought to have divided stalls, at least five feet wide each, that they may lie at ease; and every horse feed separately, and, if he choose, that he may *feed leisurely*, whatever be his provender. The stalls may slope, say one-eighth of an inch to the foot; from the bottom of the wall, below the manger to the gutter, which may be ten feet from that wall, and two feet from the back part of the division. There ought to be five feet for a thoroughfare between the gutter, and the other side-wall, behind the horses. The length of the stall will admit of a *broad-bottomed* manger, for holding clover and other green herbage for soiling. The racks will not hold enough of this fodder, and its weight compresses it so much, that the horses cannot, without difficulty, draw it out. Green herbage should be divided between the manger and rack, when working horses are foddered up for the night. Stables in which horses are soiled, ought to have openings in the roof, for allowing the heated air to escape in hot weather, and which can be shut in cold. The width will allow of shelves and pins for the furniture of each pair of horses, immediately behind their stalls.

Cattle in general have by far too little room. Working oxen, large feeding cattle stalled, and milch cows, should have stalls four feet wide, or even more, and as long as those of horses. Were all those animals fed separately, they would no doubt thrive much better than when they are fed in common. Cattle should be foddered at the head, and littered and cleaned from behind. They should stand single, unless they are of the *same age*, and have been *bred together*. Cattle suffer much from being huddled together, and stewed close up in a low-roofed cow-house in winter, particularly milch cows, more especially if sent out to drink cold water in frosty weather, when in a heated state. The urine of both cattle and horses should be carefully collected, by means of retentive gutters, into reservoirs, and carried out and regularly sprinkled over the surface of the dunghill. Much valuable manure is lost, by neglecting to have these accommodations erected along with the buildings in which the stock is to be kept.

Where economy *must* be attended to, separate stalls may be objected to on account of the expence: in that case a pair of work-horses may

eighteen feet wide, upon the supposition that the horses all stand with their heads to the wall, which is the custom for farm-horses in all stables recently built. In this way the access is easy in the longest stable, both for removing the dung, and supplying the horses with provender. With respect to cattle, he adds, that it requires three feet eight inches to give due room to a bullock of 45 stone Amsterdam weight; and if the house is fifteen feet in breadth, or at the most sixteen feet, cattle may not only be comfortably accommodated, but full access permitted to supply them with food, and remove their dung. Many cattle-houses are not made more than fourteen feet in width, some of them even less; but fifteen feet may, on the whole, be considered as a very proper size. At the same time, where the expence can be afforded, more ample space may be given, and will probably be found advantageous.

4. It is maintained by some, that the farmer should have a view, from a window in that room where he usually sits, of what is going forward in the farm-yard,\* the very idea of which, it is said, keeps the servants in awe, and may often prevent negligence and depredations. It is certainly desirable, that the farmer should be able to command a view of the other parts of the farm from the windows of

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be accommodated in a space of sixteen feet by eight, leaving room for bringing them their food and litter, and carrying away the dung. Cows require nearly the same room in the breadth of the cow-house, but usually stand much closer together; so that on the average six feet *may* serve two cows for the above purpose, where the breed is not large. In many feeding-houses for cattle, for the convenience of feeding at the head, there are holes left in the wall, with shutters, to allow of putting in the food.

\* It is known that a farmer has on every door a large patch, painted of a different colour, as white upon black or black upon white, that he may see at a distance when any one of them happens to be open.

his house, if a situation sufficiently elevated for that purpose can be obtained.

5. The house should be situated at a moderate distance from the offices, say from twenty to forty yards. When in the line of the square, the farmer and his family are distressed with the unwholesome vapours of the dunghill, which are also extremely unfavourable to the keeping of provisions.

6. It is of great importance to have either a pavement, or a good road, all around the farm-yard and dung-pit. Farmers suffer more than is commonly imagined, by having their carts and cattle struggling in farm-yards, through piles of straw and dung, where this is neglected.

7. It is highly expedient to raise the party-walls above the roofs of the offices, to prevent the communication of fire, more especially where the offices are thatched.

8. It is also desirable to have two reservoirs for urine, when cattle are stall-fed in any number. As soon as one is full, it should remain in that state till it becomes putrid, previous to its being taken away, and the other in the mean time may be filling. This plan is strongly recommended by Mr Allan of Craigcrook, near Edinburgh. It is likewise proper, in order that the urine may be as strong as possible,\* and to prevent an accumulation of wet, that the buildings should not admit water to go inwards from the roof, at least in wet climates, but that where water is likely to

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\* It has been remarked, that urine may be too strong, unless it is diluted; and that if it is kept too stale, some of the most valuable parts of it may evaporate. There is certainly no better mode of applying urine, than to mix it, as soon as possible, with peat, or if that cannot be had, with fine earth, or straw, tanners bark, or saw-dust.

be too abundant, it should be taken away by spouts and drains.\*

9. It is evident that the access to the house and offices should be as commodious as possible. The road should be kept in good order. The corners of the garden and inclosures to be rounded instead of square, by which, owing to the great facility of turning, many accidents may be prevented, injurious both to the carts and to the cattle.

10. A command of water is essential; it is desirable, therefore, that the house should be situated near some river or stream; but if that cannot be obtained, ponds and wells, and the means of conveying water by troughs to the feeding-houses, both for horses and cattle, and to the dairy, should be constructed. Nothing can be more injurious to stock, than to compel them to drink at ponds, the water of which is not perfectly salubrious. A bore, made according to Elkington's plan, would in general raise water to supply any part of the offices.

11. As an appendage to farm-houses, a kitchen-garden is of infinite importance, and may be more profitable to the occupier, than any part of his farm of the same size. This is certainly less essential, since potatoes, turnips, and other articles have been cultivated in the fields; but still it is expedient for a farmer, to have a garden for other articles;

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\* It is said, that where abundance of litter is given in the yards, it hardly ever happens that too much wet gets to them, and that there is sometimes a want of moisture in dry winters. There must, in this respect, be a diversity in practice, between the eastern and the western districts of the kingdom. On the eastern coasts, the water that falls from the roofs, may be required, for the litter, though it would be much better to saturate it with urine, and to take great pains in collecting it for that purpose. In dry seasons, on the coast, sea-water may be used with great advantage.

to enable him also to try experiments, with new plants, on a small scale; to train up his rising family to an attention to such objects, and to furnish his table with small domestic luxuries, which no farmer would be willing to purchase, if he can procure them at home.

12. It is a peculiar feature of the improved husbandry of Scotland, that in all the best cultivated districts, cottages are considered to be as indispensable as a barn or a stable. They should be placed at some distance from the farm offices, and it is desirable that there should be a small byre for their cows, near their houses, so that the women and children may have no pretence to come near the farmer's offices, except when called on. These byres should be accessible at all times to the farmer, or his confidential servants; and an allowance of straw and hay, (or sometimes a few turnips) should be regularly served out, and divided among their owners, at a certain hour every day. If the cows are not soiled, it is not uncommon to keep a field in grass, near the cottage, for the summer pasture of the servants cows; but if the farmer resides on the ground, they usually pasture along with his own.

In conformity to these principles, the annexed sketch has been drawn up, pointing out the proper position of a farmhouse and offices, accompanied by the plan of a farm, whether the soil be of a strong or of a light description; and explaining the rotations adopted, according to the most improved systems of Scotch husbandry.

It would be entering into too wide a field, to dwell on the various offices necessary for the accommodation of a large farmer, more especially as that subject is very fully detailed in a valuable paper, printed in the communications to the Board of Agriculture,\* and will be fully explained in the

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\* See a paper on Farm-buildings in general, by Robert Beatson, Esq.

General Report on the Agricultural State of Scotland, now preparing to be laid by the Board of Agriculture, before his Majesty, and both Houses of Parliament. But it may be necessary to dwell on two points: 1. The construction of convenient places for feeding cattle, for the purpose both of consuming the turnips, and the straw raised on the farm, and for converting the surplus straw into dung; and, 2. On the best plan of a stack-yard.

In regard to the feeding cattle, three plans have been suggested for that purpose: The first is to feed them in large open yards; the second, in feeding-houses; and the third, in small open sheds, or what, in Berwickshire, are called *Hammels* or *Hemmels*, with separate straw-yards attached to each.

The plan of fold-yards is certainly the cheapest, being in general formed by the offices which afford shelter to the cattle; but where a number of animals, of all sorts and ages, are suffered to mingle together, many accidents must happen, and the cattle must often be injured, by going through a yard full of straw and dung, and often very deep, in which they are apt to sink,\* and by master cattle preventing the others from feeding. Though this plan might answer for young cattle, where divisions are made by walls or hurdles,

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Communications to the Board of Agriculture, v. i. p. 3. But by far the best plan of a farm-house and offices hitherto published, is to be found in Mr Kerr's valuable report of Berwickshire. It is founded on actual experience, and comprehends every convenience essential to the accommodation of a large farmer.

\* This is often the case, though in well-regulated farms the dung is never suffered to remain in the court or fold-yard, but is carried out, before it becomes so rotten that the cattle can sink in it. This is sometimes done in wet weather, that the dung may have sufficient moisture to make it ferment, but is better done in frosty weather, when more can be carried in each cart, and the fields are less liable to be poached.

yet it would never do, for feeding valuable cattle for the butcher.

Feeding-houses are, in some respects, well calculated for fattening cattle, and are less objectionable in the immediate neighbourhood of a market. The animals are kept warm and quiet, and each can have the due portion of food allotted to him; but the animals having no exercise when thus stall-fed, cannot be so healthy, nor the meat so wholesome, as when kept in fold-yards or open sheds. The legs of cattle also, more especially in the case of heavy oxen, when confined to one spot, are so apt to swell,\* that they are hardly able to go to any distance. Where a less confined mode of feeding is adopted, the cattle not only thrive better, but the expence is considerably less.

On the whole, the third plan, that of Hammels, though the most expensive, yet is certainly to be preferred. I first had the satisfaction of seeing them at Mr Robertson's of Ladykirk, in Berwickshire. An engraving of this excellent plan is annexed, which will give an idea of the form of the construction. The advantages of it are described by Mr Robertson in the following terms: "I have found these hammels or cattle-sheds, much better than any large or open court and yard. Cattle kept in great numbers, waste more straw, they fight, and hurt one another with their horns. All this is prevented when they are kept in separate divisions; and, above all, in these hammels, we can give them what meat we choose, and in what proportion we think proper; and can separate those of different ages, which ought not to be associated together."

This plan, however, is not confined to cattle; a spirited

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\* It is remarked, that the legs of cattle fed in stalls on yams, or exclusively on raw potatoes, are particularly apt to swell.

farmer on the estate of Ladykirk, having long used exactly the same buildings for his horses, and with very great success. He had lost none by death for a number of years, and they seldom have colds or any other disease.\* His horses lie in these open hammels in winter, and it is remarked, that in frosty weather, when snow is falling, and lying on the ground, the animals do not go under cover, but prefer to lie out, with their backs and sides covered with snow. It is well known, that if a horse is kept out in winter, he will have no grease, nor swelled legs, and perhaps no other disease. These hammels seem to have all these advantages, at the same time that they protect the animal from damp, and prevent his back from being kept wet by heavy or long-continued rains. Every farmer who keeps a large stock of horses, occasionally loses one by inflammation, brought on by coughs and colds; but the horses of the farmer alluded to, become aged, and he has not had occasion to purchase a young horse for several years. It is evident, that horses taken out of a warm stable, perhaps with some degree of perspiration on them, when they stand behind a hedge in a cold day, either to have their corn given them, or when the servants are taking their dinner, must be much more liable to catch cold, than if they had been hardened by being kept in open sheds in the manner above described.

The celebrated George Culley, (whose death the agricultural world has recently had reason to lament) though he approves much of the *hammels*, or sheds with a small fold, or *curtain*, annexed to them, where only two or three cattle

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\* Mr Kerr fully confirms the advantages of this plan, having repeatedly seen these open-horse hammels at Mr John Herriot's, tenant at Ladykirk farm; each shed holds two horses, with a niche for their harness. To each there is an open small straw yard. Each has a water trough, and each a gate large enough to admit a cart to take out the muck.

can be kept in one place, yet observes, that few farmers can have such expensive conveniences. Almost every farmer, however, can have open sheds, and folds adjoining, with mangers under the sheds, and close wooden hecks, or standing mangers in the folds, where from six to twelve steers or queys can be kept together, and are at liberty to feed and rest, either in the sheds, or the open parts, and although the master cattle will eat where they chuse, the rest have so many places to eat at that they are never at a loss. It is found that cattle thrive best in this way. Those who are so disposed, make exceedingly fat, and the slower feeders, are always fitter to turn into the pasture in May, than when tied up under either shed or byre. This mode of feeding, therefore, is now generally adopted on both sides the Tweed. If a very wicked mischievous beast happens to be amongst the lot, it must be put by itself. It is to be observed, that the steers and queys, are always kept in separate folds, and are now universally made very fat when three years old.

The proper arrangement of a stack-yard, is of more consequence than is commonly imagined, and is capable of much improvement.\* It is a common practice, to begin building the stacks at the corner opposite to the entering gate from the farm, packing them as close as possible, by which they are deprived of air, and if any of them should shew a tendency to heat, it is extremely difficult to get them turned over, or put into the threshing mill. Mr Mitchell of Balquharn near Alloa, has arranged his stack-yard on principles peculiarly well planned and judicious.

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\* In the Berwickshire Report, p. 86, the rick-yard is directed to be ploughed into twice-gathered ridges 21 feet broad. By this means, as the ricks seldom exceed 12 feet diameter, there are 9 feet free between the rows for air and carrying in sheaves. No allowance for heating, as a good farmer has no heated stacks.

His stacks are divided into regular rows, and there is a road on each side of every double row, besides a road round the whole yard.\* This plan is attended with the following advantages: 1. By these parallel roads, there is a greater degree of ventilation; 2. He can remove any stack he pleases, as necessity or markets may require; 3. In the hurry of harvest, there is no confusion or loss of time, whatever may be the number of men or horses employed; and, 4. By having the rows and the stacks regularly numbered, there is no difficulty in ascertaining what each field of the farm produces. That plan was originally suggested by that respectable agriculturist Mr Erskine of Mar.

Two points on the subject of farm-houses and offices in general, remain to be discussed: 1. By whom they ought to be erected; and, 2. By whom they ought to be kept in repair.

In regard to the first point, it is certainly desirable, as a general principle, that the landlord, who has a permanent interest in the soil, should be at the expence of all substantial improvements.† But unfortunately that cannot be the case in regard to entailed estates, where the proprietor has

\* As four rows, if the stacks are pretty large, will in general be sufficient, two roads will be enough, one through the middle of the longitudinal direction, and one round the whole yard.

† Mr Church of Hitchill in Dumfries-shire, observes, that the farm-house and offices ought to be erected free of expence to the tenant. Many an industrious individual has got the character of a bad farmer, by having been unguardedly led to exhaust his capital on buildings, so much so, as to disable him from bestowing a proper proportion of it on the cultivation of the soil. Inclosing ought to be done at the expence of the landlord, and the fences reared or maintained at the mutual expence of landlord and tenant. In short, all great permanent improvements on a farm, should be executed by the landlord, and in consideration of these, let the tenant pay a higher rent.

only a life-interest in the property, and cannot borrow money for expensive erections, notwithstanding the provisions of an act for promoting the improvement of such estates. Sometimes, also, the tenant has a greater command of ready money than the landlord, and will lay it out with more economy, and to more advantage. In that case it may be most advisable for both parties to arrange a plan, by which the buildings are to be erected by the tenant, the farm being let proportionally, at a lower rent, and he receiving a certain sum for those buildings, according to their value, at the termination of his lease.\* It must be acknowledged at the same time, that every plan, which tends to abstract the tenant's capital from the culture of the grounds, is unfriendly to the interest of agriculture.

As to repairs, the farm-houses and offices in the more improved districts of Scotland, are usually built in a sub-

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\* Mr Milne of Alvalh, near Banff, remarks on the subject of farm-buildings, that few farmers have capital sufficient for a farm of 200 acres, the expence of stocking which, at a moderate computation, costs £.2000 sterling; and if new houses are required, which very often happens, *a great deal more is necessary*. Any allowance the proprietor gives for building, is seldom or ever paid until the end of the lease; the tenant's capital is thereby very much drained, before the fields can receive much benefit. It also often happens, that the outgoing tenant has a considerable claim for houses, and in many instances they are so ruinous, that the farmer can neither trust himself or cattle with any degree of safety, but he must be at a great expence in repairing them. In such cases, the landlord should certainly give every assistance he can afford. In regard to the plan of valuing *the whole premises* at a tenant's entry, and again when he removes, it is remarked by an intelligent correspondent, that such a system is *rather hazardous*. The price of wood, its workmanship, and other materials, vary so much in the course of a lease of even nineteen years, that he has known a tenant, to receive a great surplus sum at his removal, without his having laid out a single shilling, the value of building materials having so much increased.

stantial manner, and it is in general the practice, that the tenant shall keep the house in repair. It is a great addition to the landlord's income, to be exonerated from so heavy a charge, which in England amounts to from 5 to 15 *per cent. per annum*, on the rental of farms above 100 acres. In Berwickshire, the calculation is, that a thoroughly well-built farm-house and offices, which must cost about L.3000, ought to be kept in repair, during a lease of 19 years, for L. 100 in all, and left in thorough repair for an equal sum, which will only be at the rate of 10 *per cent.*, on one year's rent; and will hardly exceed  $\frac{1}{2}$  *per cent.* on the rental *per annum*; and in Scotland, laying the repairs on the tenant, is rarely found to be attended with any material loss.

On the whole, it can hardly be questioned, that it would make a difference of from L. 50 to L. 100 *per annum*, in the expence of labour, where the particulars above mentioned have been properly attended to, when farm buildings are erected.

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### SECT. III.—*Size and Shape of Fields.*

THIS is a point, which, in so far as regards arable culture, has been brought to a considerable degree of perfection, according to the system of husbandry adopted in the more improved districts of Scotland. Nothing can be more absurd, with a view to the culture of grain, than to have a number of small inclosures, irregularly shaped, surrounded with high hedges and trees; and such a system perhaps general in a flat country, where so much shelter is unnecessary. Such a plan is peculiarly reprehensible, where horses

and cattle are the principal objects of attention, as soiling, (or giving them cut green food in yards, or houses) is greatly preferable to pasturage. On these grounds, it is proper to explain, what in Scotland is considered to be the best size of fields, in an improved arable district, and the principles on which that system is founded.\*

The circumstances on which the size of fields ought to depend, are principally the following :

1. The extent of the farm in which they are situated ;
2. The nature of the soil or subsoil ; 3. The rotations adopted ; 4. The number of ploughs in the farm ; 5. The command of water ; 6. Access to roads ; 7. The elevation of the ground ; 8. Its being in pasturage or otherwise ; and, 9. The nature of the climate.

1. *Extent of the Farm.*—The size of fields ought certainly, in some measure, to depend, on the extent of the possession. In small farms near towns, from six to twelve acres may be sufficient ; but where farms are of a proper extent, from twenty to even fifty acres, and in some instances as high as sixty. One of my correspondents indeed states, that his inclosures are about twenty Scotch, or twenty-five English acres each, and that he would certainly enlarge them, were he not restricted to that size by his lease. Mr Brown of Markle, whose knowledge in every branch of agriculture is so well known, considers a field of thirty Scotch, or thirty-eight English acres, to be a proper medium size, when permitted by local circumstances, for large farms.

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\* So inveterate is the prejudice for *small fields* in England, that though the expence of fencing has now become enormous, they are still persevered in, even in new inclosures, under the authority of acts of parliament, by which the charges of that important branch of agricultural improvement are greatly increased.

2. *The Nature of the Soil and Subsoil.*—The best size of fields for arable cultivation, must always depend upon the nature of the soil and subsoil. When the soil is chiefly dry, it is of consequence to have the fields large, as it tends to accelerate the ploughing, harrowing, reaping, &c.; but when it happens to be strong clay, it then becomes a matter of prudence, to contract the size of the fields, chiefly for the purpose of keeping them as dry as possible.\* In dividing a farm, however, it is proper to separate the light and the heavy soil. They are not only better calculated for different crops and different rotations, but are fit to be wrought at different seasons. It is a fortunate circumstance, when a farmer possesses as much ground of each kind, as will make a full rotation, so that both may be carried on at the same time. In turnip soils, the following plan has been recommended by Mr Carnegie of Hailes, in East Lothian. Where the farm would admit of it, he would divide the whole into eight fields of thirty acres each, under a rotation of, 1. Turnip; 2. Wheat and Barley; 3. Grass; and 4. Oats: and he would have two breaks or divisions in each field, one half, (or fifteen acres) of the inclosure in turnips, and the other in grass; and when ready to consume the turnips, he would strip one half of them, and give them to the sheep on the grass: He would then move back the flakes or hurdles, and would allow the remaining half to be consumed on the ground, with liberty to the sheep, to pasture over the whole grass, while eating the turnips, taking care never to give the stock more than a certain number of days' turnips at a time. Thus there would be

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\* Remarks by Mr Rennie of Kimblethmont.

four fields with white crops, after turnip and grass.\* Others recommend giving the sheep as much fresh turnips each day as they can eat, as the turnips, when not consumed on the day given, are often damaged by the wet and frost, or destroyed by the sheep going over them. Mr Walker of Mellendean concurs in opinion, that on turnip soils, where it is necessary to consume the turnips upon the ground, the fields should never much exceed thirty acres, if the situation will admit them to be made of that size. When they are larger, it becomes difficult to give the sheep the quantity necessary at a time, without confining them all round with nets or hurdles, which is always attended with much loss. When one division is done, and a new one taken in, the sheep should always have liberty to fall back, and rest upon the cleared ground, which they naturally do, by which means the turnips are kept much cleaner, and a great deal of meat saved; and he has always found, that a field of the above dimensions, will contain as much stock, of any kind, as can be fed together with advantage.

3. *The Rotation adopted.*—It is considered to be a proper rule, that whatever is thought to be the rotation the most suitable to the soil, the fields should be, in some measure, apportioned accordingly; that is to say, a farm with a rotation of eight courses, should in general be divided into eight fields; six courses into six fields; five courses into five fields, and four courses into four fields or inclosures.† That rule is laid down by Mr Murray, (Kirkland-

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\* It is stated, as an objection to this plan, that the grass land could not be ploughed and sown, till the turnips were consumed, which would render it impossible to have autumn wheat upon the clover ley, and even the oats in March, could not be sown in time for the last of the turnip.

† The size, it is said, should be equal to the fallow-break, or the portion of the farm under fallow. The fields under fallow should be of the

hill), with a view of having the whole field under one crop. At the same time, on a farm of 400 acres, under a four years' rotation, instead of having four fields of 100 acres each, it would be better to have the farm divided into eight fields of 50 acres each, and having two of these fields under one kind of crop. It is proper likewise to observe, that where the climate is uncertain, and the soil various, the following judicious practice has been adopted, that of having a proportion of every kind of grain cultivated in the strong part of the farm, and another portion in the lighter part. This gives the tenant a fair chance to have an equal crop, whether the seasons are dry or wet, and whether they are favourable to the one species of soil or crop, or to another.

4. *Stock on the Farm.*—It has also been observed, that the size of the fields should be somewhat in proportion to the number of horses and ploughs on the farm; for instance, where six two-horse ploughs are kept, and where it is difficult, from the nature of the soil, to keep fields of a larger extent sufficiently dry, fields of from eighteen to twenty-two English acres, are considered to be a convenient size: there is less risk, in that case, of being overtaken by bad weather, and prevented from completing the preparation of the land for the intended crop; for with twelve

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average quantity of the farm, and the other crops will become so of course. Every farmer of experience endeavours to have, and knows the comfort of having, the produce of the farm, as equal every year, as the soil and circumstances will admit of. On this subject, Mr Stewart of Hillhead remarks, that though it may answer the farmer *in possession*, to have the farm divided according to the rotation he practises, yet that it will be found generally advantageous *for the proprietor*, to have it divided into double the number of fields that may be required for a four or a five years' rotation, in case any alteration of system should become necessary.

horses in the spring season, a field of that size, can always be finished in four days.\* In regard to the live stock not employed in the culture of the farm, it is well known, that cattle feed better in small numbers, than in great herds.

5. *Water.*—It is necessary in every field actually to be pastured, to have a supply of water, the command of which is more likely to be obtained in large, than in small inclosures. A correspondent, whose fields are small, complains of their being so ill-watered, that the stock, when pastured in some of them, cannot get a supply, even in winter.

6. *Roads.*—It is essential that each field should have convenient access to the farm-road; so obvious a point need not be dwelt upon.

7. *Elevation of the Ground.*—It is also evident, that the size of the field, ought in some respects to depend on the flatness or elevation of the ground. Even on dry land, if there is a rise on the ground, from fifteen to twenty chains is length sufficient; for where the ridge is longer, the horses

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\* Remarks by Mr Peter Mitchell in Stirlingshire, and Mr James Cuthbertson in East Lothian. On this subject, Dr Young of Stonehaven justly observes, that the fields should be of such a size, as to admit the operations going on upon them, to be finished in a short time, by the stock on the farm. If the fields are of too great an extent, in proportion to the stock kept, a considerable interval must occur between the sowing of the first and last part, especially of barley and big, where generally the last ploughing and sowing take place together; and it will in general be desirable, to have the whole fields cleared at once, in harvest. There will also be a saving of labour, particularly in the instance of harrowing a crop in seed-time; as, in ordinary sizes of fields, the sowing can be soon accomplished; by which the frequent turnings are avoided, that would otherwise take place, if it were necessary to sow the field in several portions. Whenever rolling is required, whether for grass seeds, for reducing the ground, or any other purpose, much of its benefit may be lost, in an extensive field, because, being usually done across, it cannot well be accomplished till the field is completed.

are too much fatigued, if compelled to plough a strong furrow, up-hill, farther in one direction.

8. *Pasturage*.—Where the system of grazing and tillage is alternately followed, (more especially where the fields are pastured for two or three years or more), it is convenient to have the fields about twenty-two Scotch, or twenty-seven English acres; because the farmer generally wishes to have his stock divided, which cannot well be done with larger fields, and if they are of a smaller size, too much ground is occupied with fences. Besides, if grass fields are let for pasture, such a size suits graziers best, and consequently they rent considerably higher, than fields would do of a larger, and consequently a more inconvenient description. Unless where there are small fields near the house, it is desirable to have some part of the green-crops near the farm-offices. For if the fields are all large, the whole lot of turnips or clover might be removed to the outward boundary of the farm; whereas if fields are of a moderate size, it is possible to have a part of these crops at a convenient distance.\*

9. *Climate*.—The last circumstance to be considered in determining the proper size of fields, is the nature of the climate. In dry and cold climates, small inclosures are desirable, on account of shelter: whereas, in wet countries, the fields under culture cannot be too open and airy, for

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\* Remarks by Mr Brown, Cononsyth, by Arbroath. Another correspondent observes, that some extent is desirable for fields in pasture, to attend the stock pasturing over its surface. Fields from ten to twenty acres, however, are large enough for grazing. When few cattle are put together, they remain more quiet, than when there are many, which is very desirable for fattening stock. In a wet autumn, much grass is destroyed by treading, and in large fields more grass is destroyed by the feet of the cattle, than consumed by their mouths.

the purpose of drying the ground, of bringing forward and ripening the grain, and of enabling the farmer more easily to secure it, during any unfavourable harvest, by a free circulation of the air.

It is now proper to make some observations on the shape of fields, the form of which should be square in strong, and oblong in turnip lands, uniformity of soil being at the same time attended to.

*Square Form.*—It is evident, that it is advantageous to have the fences in straight lines, and that fields when large, should be square,\* and when small, more especially in turnip soils, of an oblong form, in order that the ploughing may be dispatched with as few turnings as possible. Some people, whose farms are of a waving or uneven surface, and who inclose with hedge and ditch, carry their ditch through the hollows or best soil, with a view of raising a good hedge; thus, often sacrificing, for the sake of the fence, the form of their field. A straight line, however, is preferable, even though it should be necessary to take some particular pains to enrich the soil for the thorns, when it is thin and poor, on any elevation.† By means of the square form, an opportunity is afforded, of ploughing in every direction, when necessary, and less time is lost in carrying on all the operations of husbandry in a field of that form, than of any other shape. Where the waving form is necessary to secure proper water-runs, plantations may be so

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\* Mr Kerr justly remarks, that in hanging grounds, the ridges and furrows ought always to have so much obliquity, as to reduce the field nearly to the circumstances of one situated on a plain. The operations of ploughing, harrowing, carting, &c. are thus materially facilitated, and the filling up, or sanding of the furrows effectually prevented.

† Remark by Mr Church, Hitchill, near Annan.

disposed, as to reduce the fields to squares or oblongs, and the fences to straight lines.

*Oblong Form.*—An intelligent correspondent is decidedly of opinion, that all farms, more especially those of a light soil, are best divided into oblong fields, because, when occupied either as a grazing, or a breeding farm, oblong fields are so easily and simply subdivided, and water can almost in every case be got, by making proper ponds, in the meeting or joining of three or four fields, the gutters or ditches of which fields will convey water to the ponds. This is a great advantage in fields under a turnip crop, as it is easier to cut off, or divide the turnips with hurdles or flakes, or nets, &c., and the sheep can be fed off with the greater convenience; always keeping in view, to take off a certain proportion of drills, for giving to the feeding cattle in the sheds or folds, &c., or to sheep upon the adjoining stubbles or pastures, in proportion to the state the ground is in; land in a rich state having the greater proportion taken away. Nor is it any objection to the oblong shape, that the ridges may be too long, as that can be easily obviated by cross head-lands or head-ridges, which in any soils can be made at any place, according to the length of ridge most agreeable to the taste or opinion of the proprietor or occupier.\* Even where the land has a wet, damp, or retentive subsoil, an oblong form may be advisable, for the head-ridges can be made in those parts most suitable

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\* On this subject it is remarked, that head-lands are never admissible, except to get rid of wet, or in consequence of deviations of soil, and hence a difference of culture; and that ridges cannot be too long, where land is inclosed, as it gives occasion to fewer turnings, and is ploughed at less expence of time and labour.

for taking off the water, as well as to suit the proper length of the ridges, with gutters or gripes where requisite.

*Uniformity of Soil.*—It is necessary, at the same time, to attend to uniformity of soil, and many farmers have to lament, that the inclosures on their farms are laid out, more with a view to beauty than utility, and that regularity and uniformity of appearance have been chiefly kept in view, whilst little regard has been paid to a point infinitely more essential, that of having the several fields of the same sort of soil; hence soils of the nature most heterogeneous, are thus unfortunately mingled in the same field. One farmer complains, that this principle has been so little attended to on his farm, that he has ridges, one half consisting of a strong wet clay, and the other half of a sandy soil, fit for turnips. A spirited correspondent proposes to obviate this objection, by altering the texture of the soil. He observes, that there are fields, partly consisting of strong soils, and partly of light, where probably there are not above one or two acres of the latter, for ten or twenty of the former; and where almost every year the culmiferous crops fail on the light soils from drought. He therefore suggests, that at any slack time, whether in winter or summer, when the field is under fallow, it would be proper to employ two carts and horses, with four fillers, and to cover the acre or two of light soil, with the strong soil contiguous. Draining perhaps would, in the first place, be necessary; but the soil in the field would ever after be uniform. In fields where light soils predominate, the same plan reversed might be adopted. The principal objections to this plan, are, 1. The expence, and 2. That the subsoil remains the same; but the idea is certainly excellent wherever it is practicable.

The advantages of attending, as much as the circumstan-

ces of the case will admit of, to the principles above laid down, shall now be stated.

1. Every farmer who has attended to the subject, will admit, that it is a material drawback to cultivation, if the fields, instead of being regular in size or form, are laid out arbitrarily, without attention to any judicious system; and where the whole farm is divided into fields of various sizes, from 5 to 10, and thence to 20 or 30 acres each, it is extremely difficult to equalize them, so as to suit any judicious rotation of crops; whereas, by having fields of a proper size, the whole strength of a farm, and the whole attention of the farmer, is directed to one point, which gives an emulation to the ploughmen, when they are assembled together.\*

2. It is evident, that small fields are liable to many objections. Besides the original expence of the inclosures, and the injury to grain crops produced by want of circulation of air, and the shelter given to numerous small birds, the very site of numerous hedges, with their attendant ditches, and the uncultivated slips of land on both sides of them, rob the farm of a much greater quantity of arable land, in proportion, than when divided into large fields. The crops in fields thus sheltered, must also be more liable to disease, as the rust and the mildew, the exclusion of air encouraging the growth of *fungi*, or the mushroom tribe. Hedges and ditches likewise, more especially if accompanied with hedge-rows, exhaust the ground near them of its fertility, whence the grain is of inferior quality; they nou-

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\* Rectangular fields of considerable size are advantageous, as it may be thereby known whether the ploughmen have done their duty; that is, if there is one man in the whole who can be depended on. Indeed, in fields of this shape, the work done, is known by the length of the ridges, and number of furrows, of a certain breadth ploughed.

rish weeds, the seeds of which may be widely disseminated, or exclude the wind and drought after the crop is cut down, keeping it longer from being stacked. Even for meadows, these small inclosures are injurious, by preventing the circulation of air for making or drying the hay. Where fields, on the other hand, are of a proper size, less ground is wasted, there are fewer fences to uphold, and fewer birds to destroy; the crops of grain can be more early harvested, being more exposed to wind, and they are less apt to suffer in dry and clear weather; and though small inclosures are better sheltered in winter, which is favourable to the growth of herbage for pasture, yet the opener they are in summer the better; for in hot weather the cattle and sheep always go to the airiest places.\* But the principal argument in favour of large fields is this, that in small fields, much time and labour is wasted by short turnings, &c.; hence an intelligent farmer, (Mr Mitchell of Balquharn) has well observed, *that if fields are of a regular shape, and the ridges of a proper length, five ploughs will do as much work as six ploughs in fields of a small size, and of an irregular shape; and every other part of the business to be performed, as dunging, sowing, harrowing, reaping and leading, will be executed, though not altogether, yet nearly in the same proportion.*

Some additional remarks regarding the size and shape of fields remain to be stated.

1. Though fields, on the whole, should be of a large size, yet there is a great convenience in having a few smaller fields near the farm-house; for family cows; for rams, on farms where sheep are kept; for trying on a small scale,

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\* Remarks by Mr Robertson of Almon.

useful experiments ; also for raising tares, lucern, sainfoin, &c. and for various other purposes.\*

2. Where inclosures are found too large for particular purposes, the field may be effectually subdivided by sheep-flakes, or hurdles, a sort of portable fence, well known to every turnip-grower. When carefully set, they are a complete fence, at least for sheep. By this means great advantage is derived, from the constant use of the land that would otherwise have been occupied by stationary fences, and the expence of subdivisions, which, on a large farm, would necessarily have been numerous, is thereby avoided.†

3. In some cases, the size of fields should vary with the size of the farm, more especially when there is a diversity of soil. In a farm of 200 acres, it is contended, that there should be 8 inclosures of 20 acres each, and 4 of 10. In a farm of 300 acres, 8 inclosures of 30 acres each, and 4 of 15 acres ; and in a farm of 700 acres, 8 inclosures of 50 acres each, and 12 of 25 acres. Thus dividing a farm into eight, twelve, sixteen, or twenty inclosures, according to its extent, and varying the mode of cropping according as

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\* Remarks by Mr Robert Kerr, the intelligent Reporter of Berwickshire ; Mr Wilson of Simprin, and others. Mr Stewart of Hillside also observes, that it is often found convenient to have some small inclosed fields upon extensive farms, where the general plan of management is calculated for large fields. Besides the purposes mentioned in the text, it may sometimes be necessary to turn out young horses, mares and foals, and old horses, and to have small fields of ruta bage, and other winter and spring vegetables conveniently situated for the farm-offices, and distinct from the large fields. It might not answer the purpose, to have divisions for these in large fields separated by sheep flakes. Besides the expence and inefficacy of that plan, the succeeding crop might not suit that of the large fields.

† Hints from Mr Hunter of Tynesfield, and Mr Cuthbertson, near Prestonpans.

the soil is light or strong, the strongest soils being put into the smaller inclosures.

Of such importance does it seem to Scotch farmers, to enlarge the size of fields, to reduce their number, and to put them into as regular a shape as circumstances will admit of, that it is one of the first circumstances attended to, wherever the Scotch system of husbandry has been introduced into any part of England. By means of that reduction, a considerable extent of ground is obtained, and the land is rendered better calculated for the production of corn.

Here it may be added, on the authority of a farmer, (Mr Brown of Markle), who has paid particular attention to this subject, that where inclosures are made by hedge and ditch, the quantity of ground lost upon ten acres, amounts to not less than one-tenth, in other words, that a ten-acre field is reduced to the size of nine acres, which is a strong argument against small inclosures.

I have been led to dwell longer, than otherwise would have been necessary, on the interesting subject of this section, as it is a topic which has not hitherto been so much attended to as its importance deserves.

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#### SECT. IV.—*Of Fences and Gates.*

• IF the fields are of a proper size, it will add greatly to the value of a farm, to have them judiciously fenced. Hedges of a proper construction, with trees regularly planted in the corners of the fields, (see the annexed engravings of the plan of a clay-land, and turnip-land farm),

not only beautify a country, and improve the temperature of the atmosphere, but actually increase, perhaps from 2 to 5 shillings *per* acre, the intrinsic value of the land.

In the more improved districts of Scotland, the farmers are not partial to small inclosures. They are of opinion, that the fences take up a great deal of land which might be employed to much better purpose; that they are extremely injurious to the roads along which they may be carried; that hedges furnish a shelter for birds, which do much mischief to the crops of corn, when they are sown or ripening;\* that the want of air is extremely prejudicial to grain in all the stages of its growth, and in particular that near hedges, its quality is greatly inferior; above all, that when the crops are cut down, the produce of an open field must be ready much sooner for being brought in, than in the case of small inclosures, to which scarcely a breath of air has access. There is certainly much justice in these observations, though one of them might be obviated, were the legislature to pass an act, for limiting the height of all hedges to four feet and a half, the height at which hedges are kept by our most skilful agriculturists.

It is admitted, that inclosures are of some use to stock, as they require, if pastured in the fields, shelter from heat, as well as from cold; but where the practice of soiling is adopted, sheep is the only species of stock that ought in general to be fed out of doors, and they prefer airy situations. Where there is any old turf, or permanent pasture,

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\* Others contend, that though sparrows, and other small birds, do harm, yet, on the whole, that they are beneficial, by destroying caterpillars and the various sorts of moths, butterflies, and insects, which attack the ears of corn. Small inclosures, however, first nourish these vermin, by the warmth and shelter they afford, and then it is proposed that other vermin should be protected to destroy them.

on a farm, a high fence is desirable, for the sake of promoting moisture, which is favourable to the growth of grass; and hedges, and hedge-rows, as Mr Kerr well observes, give a rich and sheltered appearance to a country, while the want of that ornament occasions many fertile and highly cultivated districts to appear neglected, cold, and desolate.\*

The sort of fences chiefly known in Scotland are:—1. Open drains, which, incidentally at least, answer the purposes of a fence; 2. Stone walls; and, 3. Thorn hedges.

1. Open drains sometimes answer the double purpose of dividing fields, and of freeing them from superfluous water; and they are not liable to some objections, which have been urged against other sorts of fences. Where stock, however, are pastured in fields thus separated, unless accustomed to that sort of fence, as in Carse-lands, they sometimes fall into the ditches, and are killed or materially injured; and if any paling is erected to prevent such accidents, it seldom lasts long.

2. Stone walls are of various descriptions. They have one advantage, that, according to a common saying, "*They are major from their birth;*" or, in other words, are in their greatest perfection as soon as made. They have, however, this disadvantage, that they are getting worse every day. The propriety of erecting such a fence, depends much upon the nature and quality of the stone, the vicinity of the quarry where it is dug, and the possibility of

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\* Berwickshire Report, p. 132. Others contend, that a farmer is not bound to attend to appearances, but to the real advantages of a system; and that where sheep are pastured as stock, moveable fences of hurdles or flakes might supersede hedges on dry soils, in the four-course husbandry. Others contend, that hurdles are a very unsafe and expensive sort of fence, only fit for temporary purposes.

obtaining lime at a moderate expence, by which the construction of the wall can be so much improved, and rendered much more durable. Where all these advantages are combined, stone walls, though not so ornamental as hedges, yet are preferable in point of utility; for the benefit of the inclosure is immediate.

Among the various sorts of stone wall usual in Scotland, there is one, known under the name of the Galloway or snap-dike, of which it may be proper to give some account. It was invented in that district, and thence has spread over various other parts of the kingdom. Mr Smith, in his very able survey of Galloway, has given the following description of this species of wall: It is built, for the most part, two-thirds or three-fourths of its height double, *i. e.* the two sides are formed of two different sets of stones, resting against each other, and connected together by stones, which from time to time are laid across the dike. On the top of this double dike, a set of long stones are laid horizontally across the dike, projecting a little on each side; and above these, the remainder is built single, which, from the irregular figure of the stones, leaves apertures through which the light appears.\* There was a great improvement on this mode of fencing invented by the late John Macadam, Esq. of Craigengillan, by putting on the top of the dike, as close as they can be laid together, stones placed edgewise; and when a considerable extent has been thus laid, thin stones are driven in, like wedges, at small intervals, which bind the whole so firmly together, that, when well built, a stone can hardly be taken out of the top without an iron-crow.†

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\* General View of Agriculture of Galloway, by the Reverend Samuel Smith, p. 83.

† Ditto, p. 87.

3. The white thorn is considered to be preferable to every other plant for a fence, being, when placed in a proper soil, a quick grower, becoming strong by age and attention, not running at the root as the black thorn does, and having prickles for its defence.\* It certainly requires continued care for a number of years, in order to be rendered a good and permanent fence; but when properly trained, and occasionally cut over, or dressed in the wedge-shape, it will last for ages.† If suffered to grow too tall, it always makes a bad fence, becoming open below, and from its height, the crops around must be injured. When hedges therefore come to a proper height and strength as fences, they ought to be cut into the shape of what is called a *hog-main*, *i. e.* brought to a point along the top, and preserved in that form by yearly switching.‡ This can generally be done for a farthing *per* rood of six yards six inches each. This plan ought always to be adopted along the sides of roads, as it keeps them dry, and preserves them from being broken up.

Hedges are often accompanied with hedge-rows, and sometimes by what are called belts of planting.

\* See Kames' Gentleman Farmer, p. 272.

† See Kerr's Berwickshire, p. 186. There is some reason to hope, that the Cockspur thorn of America, may in some respects be preferable even to the white thorn; and for trying that experiment, considerable quantities of seed have been commissioned from America, by the Board of Agriculture. Along the sea coast, the *Tamariska Gallica*, or rather the *Germanica*, has been recommended, as not likely to be materially affected by the sea breeze.

‡ The only objection to this is, that the farmer has frequent occasion for the cuttings of strong hedges to form temporary fences. But in opposition to this it may be urged, that good fences cannot be obtained, unless the hedges are regularly switched; and that if they are allowed to stand, till a crop of wood or cuttings can be procured, the real object for which they were planted, will not be accomplished.

As to hedge-rows, Mr Wight of Ormiston very justly observes, that he considers them destructive to the fences themselves, as thorns never thrive near the tree-roots, nor under the drop of the tree. The roots, running into the field in all directions, never fail to break and damage the plough, and to interrupt the operations of the field. The corn growing under the shade and drop of the trees, is almost universally laid down, of course not filled, unequally ripened, and not so soon ready for the stack-yard as the other parts of the field. In late and wet seasons, the corn is never harvested in proper condition, and in many instances it is totally lost. The grass under the drop, is also of inferior quality, compared to the other parts of the field, and is unwholesome to cattle and horses.\*

In regard to belts of planting, they are peculiarly useful in hilly countries, from the warmth and shelter they afford. There is every reason to believe, that in such situations, beech is the best hedge, the old leaves remaining till the new ones sprout out, and shelter being thus given to the adjoining fields, even in the midst of winter. They must be strong or woody, however, to turn horses or cattle.

In flat countries, it is by far the best mode, to plant the corners of fields, which are not accessible to the plough, and where a great deal of useful timber may be raised. In the annexed engravings, that system is explained. It is pro-

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\* A respectable correspondent farther remarks, that hedge-row timber, especially ash, is a fatal enemy to corn. The influence of the roots, in attracting moisture and fertility, may be seen in a circular form, on every arable spot in their immediate neighbourhood. They are in fact the landlord's *thieves*, who steal from the tenant's crop every year, ten times the value of their own improvement. The same disadvantage is felt from trees in gardens. When trees also are cut down from hedge-rows, the thorns which grow among their dead roots generally die, especially if the trees cut down are of the fir tribe.

per to give a curve to the clump, that the plough may be turned more easily; and one pond, properly placed, will water four fields.\*

It is well known how expensive it is found in England, to make fences in new inclosures, owing to the price of posts and palings. That difficulty, however, is obviated by a plan adopted by William Forbes, Esq. of Callander, in the county of Stirling, of which he gives the following account.

Mr Forbes first causes a ditch to be cast five feet wide, and three feet deep. The mound is between four and five feet broad at the base, and of the same height. In this mound, with a margin of one foot back from the ditch, the hedge is planted. Beyond the mound a second ditch is cut three feet wide and two feet deep, or as deep as the bank can be made to stand. The whole fence, including the two ditches, occupies the space of about fourteen feet. By the time the hedge becomes a fence, the ditches are filled up completely by the earth of the mound, so that no ground is lost.

Mr Forbes also sometimes incloses the face of the mound, in which the hedge is planted, with turf on both sides, the height being four feet and a half, which in the course of a year settles at four feet. This mound is soon covered over with a sward of grass, and at the same time that it is most efficient, it forms the most beautiful fence. The width of this mound at bottom, is five feet; at top it is from 12 to 14 inches. By the time that the hedge has become a fence, the mound forms an excellent top-dressing, the ditches are

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\* The clumps in the engraving, are proportionably to the fields, on a larger scale, than necessary, when this plan is carried into execution.

filled up, and no more ground is occupied, than that which is taken up by the hedge.

These hedges are planted in single rows at the distance of four inches from each other; and at every three yards' distance, a plant of oak, elm, beech, or other valuable wood is inserted, for a hedge-row. The thorns are purchased when seedlings, and trained up in a nursery upon the estate, for two or three years before they are transplanted into the fences. By this process they are naturalized to the soil and the climate.\*

By this means the expence of a paling, for defending the hedges, and the vexation of having that paling destroyed or stolen, which must often happen in populous districts, where wood is scarce, are prevented.

These modes of fencing adopted by Mr Forbes, have been carried on, not on a trifling or unimportant, but upon a great scale; for constructing the fences on the Callander estate, no less a number than six millions of thorns have been planted, and the line of these fences measures about four hundred miles in length. The trees of various kinds planted in the hedge-rows, amount to above 200,000.

If a farm is inclosed by thorn-hedges, and under the

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\* See Dr Graham's most valuable Survey of the County of Stirling, p. 123. It has been observed on this plan, that the thorns should be planted at nine inches and even a foot, instead of only four inches distance from each other. The celebrated Bakewell, and even before him Mr Ralph Ward of Guisborough in Yorkshire, above 60 years ago, found, by repeated trials, that half a yard was the proper distance for quicks. The closer they are planted, the more they die off: and it is well known that any quick hedge, 20 or 30 years old, is in that proportion, few of the thorns being nearer than half a yard from each other. When planted about a foot however, they make more wood, and become sooner a strong and lasting fence.

alternate husbandry of tillage and pasturage, it is an excellent rule, when the fields are broken up, to cut down the hedges, in order to admit the wind. In this case they may be cut down according to circumstances, either to about six inches from the ground, or to between three to four feet, the former if the hedge is thin, the latter if of sufficient thickness. In the former case, all gaps ought to be carefully filled up by planting. In the latter case, the breast or face, is shorn to the stem. Gaps are best filled up, not by planting, but by laying down branches in the gap, which take root.

In regard to gates for farming purposes, they ought to be strong and durable. The pillars or gate-posts, where blocks can be had of good quality and sufficient size, are often made of a single stone, being greatly preferable to timber, as not liable to rot. Sometimes round pillars are built of stone and lime, at other times oak, or larch, are employed, being more durable than even foreign fir, and sometimes living trees, of a proper size, are transplanted, with their roots, and are found to answer.

An excellent material for a field gate, is sound red fir, which is not very heavy, and is not liable to rot for some time. Of late, cast-iron gates have been constructed in Scotland, which can be made fully as light as those of wood, and may be manufactured to any extent.

Gates are sometimes folding, consisting of two parts, which is necessary in wide spaces, where one gate, occupying the whole, would be too large and heavy; but the swing-gate, which turns on hinges at one side, and fastens by a latch at the other, and may occasionally be shut with a padlock and chain, is the most common in fences.

Some improvements in the construction of gates, have been suggested by Mr Menteth of Closeburn, and Mr

Easton at Springkell, in Dumfries-shire, which will be fully explained in the General Report of Scotland.

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SECT. V.—*Of Draining.*

THERE is hardly any point to which an industrious and skilful farmer would be more inclined to direct his attention, when he commences the occupation of a farm, than the state of its drainage; for on that the success of his future operations must essentially depend. “Lay your land dry, whatever may be the method pursued, or the expence to be incurred, before you attempt any thing else,” was the maxim of the celebrated Arbuthnot, and is the basis of good husbandry.

Mr Robertson of Ladykirk is of opinion, that with the exception of a few districts of dry loam, the greater part of the counties, both in England\* and Scotland, stand more

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\* In Essex, draining is found to be so essential for land under a regular system of cultivation, or even in pasture, that they will go to the expence of making small ditches over a whole field, filled with small stones, brush-wood, straw, &c. so as to collect the surface-water into what may be called veins or small reservoirs, though it costs from L. 15 to even L. 20 *per acre*; and though the effects will not last above twenty or thirty years. This system, however, is often carried to excess, and the enormous expence attending it may be prevented, by adopting the principles which I believe were originally discovered by the celebrated Elkington. He ascertained, that in fields where the strata are not regular, there are often masses or *pots* of sandy soil, which absorb great quantities of water, and which, when over full, occasion what are called *lund-springs*, which, though only occasional and temporary, yet cause much

in need of draining, than of manuring; and that there are very few districts in either kingdom, where a perfect knowledge of this essential source of improvement, is at all general. The difference it would make, were draining in Scotland carried to the extent it might be, is beyond all calculation.

In discussing this important subject, it is proposed briefly to touch upon the following points: 1. The nature of the open drains made in Scotland; 2. Of under-drains; 3. Of Elkington's mode of draining, as practised in Scotland; 4. Of ponds made from drains; 5. Of the obstacles to drainage in Scotland; and, 6. Of the advantages which have been derived from it, at least in so far as these particulars have been explained in the course of my recent correspondence.

1. It rarely happens, that any clay district can be cultivated to advantage, without open drains, of various descriptions. In the Carse of Gowrie, the large drains, near the river, are from fifteen to twenty feet deep, and that valuable district has thus been rendered completely dry. In the summer season, it is necessary to clear all these large drains every year, so that the passage of the water may meet with no resistance; for there are miles of drains so connected, that an obstruction of six inches above the level, will impede the whole. It is necessary also to employ spademen every day the ploughs are in the field, to clear out the small drains as soon as the ridge is ploughed; for in that flat country,

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damage to the fields in which they take place. With uncommon sagacity, Elkington discovered, by the herbage and other outward appearances, where these pots or strata lay; and by making ditches from one to another, so as to connect them together, he drained the field at a trifling expence, as effectually as it was done by the laborious and expensive method adopted in Essex.

in a ridge of ten or twelve chains in breadth, there are perhaps three or four small open drains; provincially called *Gaw Furrs*, which go across the whole field, to carry off the surface-water, and these must be cleared every time the field is ploughed.

On the subject of clay lands, Dr Coventry has well observed, that a complete drainage is absolutely essential, as the first and fundamental step to their improvement. For that purpose, it is necessary to make proper ditches, open drains or water-courses, and to keep them clear. It is evident, that unless the water collected from the different "buts" or "ridges," can easily get away, it will be to no purpose to facilitate its passage from these, or the general surface of the ground, by "water-furrows," or small cuts made by the plough or spade; and the state of the larger ditches or open drains, with their best direction, is among the first things to be attended to by a cultivator.\*

2. On the subject of under-drains, I have received an interesting communication from Mr James Andrew, farmer

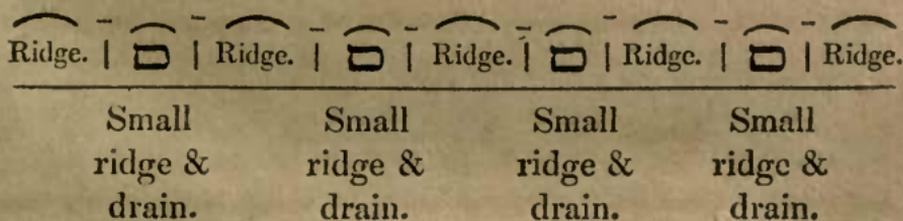
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\* An intelligent correspondent informs me, that above twenty years ago, in making drains for carrying off the water from springs in the upper part of a field which appeared to require to be taken in hollow drains, for a great distance, he observed, that the water had a tendency to disappear about the middle of the field. He caused a pit to be dug at that place, six feet deep, and equally wide. Here the water got vent. He led the hollow drain into it, and filled the pit with field stones, which were covered with twenty inches of earth. The springs of water have never since appeared. He has since done the same in various situations, by carrying a hollow drain, only so far as the water appeared. Sometimes a gravel, and at other times a rocky bottom might be found, at five or six feet deep, which absorbed the water, and rendered farther draining unnecessary.

This is a good plan, where the water does not again burst out, which often happens where the stratum does not end either in the bottom of a river, or in the sea.

at Tillylumb near Perth, who has invented a plan which seemed to him a new one, though it will appear, that it afterwards has been tried in foreign countries with success; but that does not lessen the merit of the ingenious cultivator who first attempted it in Scotland.

Mr Andrew states, that the ridges on his farm had formerly been broad, and much raised. His predecessor had levelled them by the plough, and when he entered into the farm, almost all the good earth had been thrown into the old furrows, and completely buried; the crowns of the old ridges were at the same time so much stript of soil, that they were scarcely fit to carry any thing. It was absolutely necessary, however, to do something to bring the ground into a better state. As it lay on a gentle slope, cross draining was attempted, but ineffectually. He had then resolved to gather up the ground to the old ridges, by as many ploughings as might be necessary to raise them nearly to their former height, and to *throw a drain into every furrow*, thus designing, by one operation, to dry the ground, to equalize the soil, and to give it a fallow. When these operations were completed, he gathered up a small ridge into the furrows above the drains, to protect them from the surface water. The following sketch will give some idea of the nature of the operation :



The breadth of the large ridges depends entirely upon the size of the original ridges, which varies considerably. As to the small ridges above the drains, they are about two

yards each, and they are fully as productive as the large ones, and rather more so. Thus, it may be said, that not an inch of ground is lost by the drains, and the whole is rendered more fertile and valuable.

The drains are generally about two feet and a half deep,\* and as narrow in the bottom as an ordinary spade can conveniently work them. He always thought it necessary to go down until a solid tilly bottom was found, in order that the water might always run immediately above the till. The drain was filled to the depth of a foot, or rather more, with small stones, the undermost being always carefully laid in by the hand, and the rest thrown in promiscuously above them. The stones were then covered with a little straw, and earth above all. The expence, on an average, cannot be calculated at less than from L.8 to L.10 *per* Scotch acre; but the outlay has been amply repaid, for every object Mr Andrew had in view has been accomplished. In its former state, the ground could only be ploughed at certain times. The farmer was at the mercy of every season, and found none so dry, that in a certain degree he did not suffer some injury; *but now, he can plough almost at any time, the seed can be put in if there is but a single dry day, and in the ordi-*

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\* They are cut so deep, as to have what may be called a case in *the till*, or hard clay, for the stones; and to obtain that advantage, a considerably greater depth was sometimes required. When this could be obtained at two feet and a half, Mr Andrew did not think it necessary to go deeper, as he found that the land was completely drained by such means. Shallowness can only be objected to in regard to durability; but the duration of drains does not so much depend upon their depth, as that the water in them has a proper run, and that they are protected from too much water from above. The natural slope of Mr Andrew's farm gave a quick run to the water; and the second object was obtained by the small ridges, as the water chiefly run in the furrows between the large and small ridges.

nary course of things, he can always rely upon a crop; the soil also being equalized, the crop is always equal. Mr Andrew expresses his regret, at seeing the mischief that has been done, almost in every corner of Scotland, by the attempts, which have been made to level high ridges by the plough; and I certainly think, that before any proprietor or tenant resolves to carry any plan of that sort into effect, he ought to examine the result of the measures which have been adopted on the farm of Tillylumb.\*

It is singular, that this plan, which Mr Andrew thought was a new discovery, should be the common system of Flanders, and should have been introduced into England by John Arbuthnot, Esq. of Mitcham in Surrey, who is considered by Mr Arthur Young as the best cultivator of strong arable land, and, indeed, the best general farmer, that he ever met with, in the course of his long experience. Mr Arbuthnot was convinced of the necessity of complete draining preparatory to every other exertion. After examining the Essex plan of three feet ridges, as a remedy against wetness, which he found well enough adapted to loams through which the water freely percolates, he was convinced, that it was not at all adapted for soils so tenacious as to merit the appellation of Clay, and that broad ridges, not exceeding two feet or two feet and a half in height, was the preferable system. The breadth he most approved of, was that of two perches or thirty-three feet; and in each furrow, he dug and filled a well-executed hollow drain, in the manner recommended by Mr Andrew. Under this system, the cleanness and magnitude of his crops formed a spectacle highly satisfactory to those who viewed

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\* *Straightening the ridges*, however, as will afterwards be explained; Sect. 1. Chap. 2, is a most essential improvement, and can be done at a small expence, in consequence of a plan invented by a gentleman in Yorkshire, which is described in the Appendix.

them. The loss of ground also was trifling compared to the Essex mode, by which, out of three feet six inches, one-seventh part was lost in the furrow.\*

There are few objects of greater importance, than to have this system extended over all the tenacious soils in the kingdom.

In regard to light soils, under-draining is a common practice. When artificial grasses are cultivated, it is usual to gather the stones upon the young grass into heaps, immediately after harvest, and to cart them off during the first winter frosts. If there is any appearance of a spout or land-spring in the field, the stones are applied to drain it off: where there is no spout or land-spring, if there is any hollow or flat place through which a cross water-furrow runs, a drain is made very near, and in the same direction, for it is of the greatest consequence never to allow any water to remain upon the field.

As to new modes of draining, Mr Pringle of Ballencrief informs me, that in his neighbourhood, common pantiles have lately been used in the making of drains. After they are dug in the ordinary way, a small hollow is made in the middle of the bottom of the drain, taking care to leave a piece of firm ground on either side for the tiles to rest upon. They are laid with their convex side uppermost, and the earth is thrown in. The tiles hitherto used, have been those thrown aside, on account of some flaw rendering them unfit to be employed in the roofing of houses, and they are sold at the kiln at 2s. per hundred, instead of 8s. 4d., the price of sound ones. A cart carries 400, which cost 8s.,

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\* See Mr Arthur Young's Letter to the Board of Agriculture, on the husbandry of three celebrated farmers, (Bakewell, Arbuthnot, and Duck-et) printed *anno* 1811, p. 18.

and are sufficient to cover twenty-two roods of eighteen feet and a half each. The tiles are fourteen inches in length, but allowing for breaking and overlaying, the average may be reckoned about twelve inches.

In the few instances which have come under Mr Pringle's observation, the water runs freely; and he has no doubt, that in many places they would be less expensive than stones, but they could not answer where the bottom of the drain is soft and muddy. It is a pity they were not exempted from duty, when employed solely for draining purposes, as some description of bricks are by a recent act of parliament.

3. Mr Newton of Currie-hill, near Edinburgh, informs me, that the soil of one-half of his farm lies on a ridge, sloping both south and north; the subsoil is a strong blue clay in the highest part of the land; but towards the north, the clay is nearer the surface, and of a worse quality, subject to spouts, which have occasioned much expence, and still require draining; but the materials are becoming scarce. The under half of the farm, in regard to soil, is various: there are some spots of a few acres, of turnip land, upon a gravelly bottom; but the greatest part of the low lands are a heavy soil, upon a clay bottom for two or three feet, and then sand. A great deal of this soil has been redeemed from bogs and pools by draining. Elkington's mode of draining was practised forty years ago by the late Mr Newton, not by boring, but by filtering.

In regard to Elkington's system for draining boggy land, it has answered completely in various parts of Scotland. Mr Wilson, near Cullen, in Banffshire, informs me, that he has had some boggy land drained effectually by means of that process; and Mr Church of Hitchill, in Dumfriesshire, has drained the mossy or springy ground on his farm, according to the Elkington system, with such suc-

cess, that he has brought it to nearly the same rotation as the land to which it is contiguous. Thus, by the exertions made by the Board of Agriculture, the principles adopted by Elkington have been successfully carried into effect, in remote parts of the kingdom.

4. Mr Robertson of Ladykirk has adopted an excellent plan in carrying on his draining operations; that of making ponds of pure and excellent water from the conductors in every field, entering and leaving the ponds continually, and very far preferable to any standing pool.

5. Mr Wilson in Simprin, in Berwickshire, strongly inculcates the advantage of draining, and laments that so essential an improvement should still be much wanted in Berwickshire, not from the want of spirit in the farmers, but for two reasons: 1. The want of stones in the low district, as there is not a sufficient quantity even to make the roads, which, in his opinion, is the first of all improvements; 2. The shortness of leases. To remedy the first obstacle, thorns or brushwood should be used; as he has already had such drains running for above nine years. As to leases, if they are not to be lengthened, the proprietor should cut the drains, and the tenants should fill them up. Freestone may be got at some situations at the expence of quarrying, as has been done in Berwickshire, by that eminent friend to improvement, Mr Robertson of Ladykirk. It may be proper at the same time to remark, that the common landstones, gathered upon the fields, hardened by the atmosphere, are much superior to any sort of quarry stones.

6. The advantages of draining are thus explained by Mr Jack of Moncur. His farm principally consists of a fine deep loam soil, of a brown colour. Its subsoil is a mixed clay of different colours, with some strata of very quick sand; and in the sand there were great runs of water, forcing itself up through the soil at all seasons, which very much in-

jured the ground, as it stopped the labour in the early part of the season, encouraged the growth of natural grass, and kept the surface in a sour state, which in time of great drought became very hard and unproductive. But when this kind of soil is properly drained, it soon appears what can be effected by this first and greatest of all improvements: it makes the land so free and tender, that half the labour prepares the ground for the crop; less seed and manure is necessary; and a more abundant crop may be depended upon in all seasons, as neither drought nor damp have any effect upon it.

Mr Allan of Craigcrook, also, considers draining to be the first improvement in agriculture, and that a large proportion of the land in Scotland, is ruined for want of it. He has drained land completely, where it was thought quite impossible, and has improved land, by that operation, that was not valued at 5s. *per* acre, so as to be worth from L. 4 to L. 5. Could money, labour, skill, or industry, be more usefully employed?

Mr Allan farther observes, that many people do not make the drains so deep as they ought to be;\* where the levels will admit of it, drains ought to be at least four feet deep, two feet wide at the bottom, and three feet wide at the top, and filled up with three feet of stones. Many, however, would object to such a drain, as too large and expensive. He affirms, that he has derived more benefit from draining a field, than he would have from both dunging and liming it; that is to say, the field carried more grain

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\* It is impossible to fix the deepness of drains to carry off springs. One invariable rule is, to cut through the stratum of gravel or sand in which the spring is found, and until a firm hard bed is got for the bottom of the drain. A great many drains are cut by far too shallow, to be of any use without boring.

for two years, by being well drained, than it would have done with both lime and dung, without being drained :— After being drained, half the manure was sufficient.

Mr Andrew of Tillylumb also informs me, that though his draining cost from L.8 to L.10 *per* Scotch, or from L.6, 8s. to L.8 *per* English acre, yet the whole expence was in a great measure repaid, in several places, by the benefit derived from the drains, in the course of the last crop alone. The spring and beginning of summer 1811, was a very trying one for land, and more especially for the crop of wheat. For about nine weeks, during the end of April, the whole of May, and the first part of June, there were incessant falls of rain which greatly affected the crop, which in general had contracted a yellowish sickly hue, from which it never recovered ; but all this time, such was the effect of draining, that the crop on Tillylumb preserved its verdure, in so much, that several judicious farmers declared, that it was not in the smallest degree affected by all the rain that had fallen.

On the subject of draining, Mr Bruce of Grangemuir observes, that the farmers north of the Tweed labour under great difficulties, in carrying on that essential improvement, for want of a law, obliging neighbouring proprietors to join in an operation of that sort. And it frequently occurs, that the only outlet to extensive swamps, is through the lands of others, who, from various causes, prefer keeping a neighbour under water. A law similar to that regarding fences might be made, that would be of infinite service. From another respectable quarter, I am also informed, that much land in his neighbourhood remains undrained, owing to the same circumstances.\*

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\* See this point more fully explained in the Appendix. It is to be

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SECT. VI.—*Of the Roads on a Farm, and in its Neighbourhood.*

THE advantages resulting from good roads need not be dwelt upon, as no country can be improved without these essential aids to cultivation. In various instances, the foundation of the improvement of several districts in Scotland has been justly attributed to them. For instance, in that fertile tract of country, the Carse of Gowrie, prior to the year 1790, there was no road, that could admit of carting through the winter or spring months; every thing was to be carried to market on horseback, and the horses often sunk to their bellies. So great was the slavery of threshing the grain, and carrying it to market along such roads, that many men, possessed of an active spirit, quitted the farming line, or went to places better situated in regard to roads. But now, the turnpike-roads in that district, are as good as any in the kingdom, and by the judicious application of the statute service-money, the greater part of the farmers have been enabled to make good private roads to their own doors, by means of which, 32 cwt. of coal may be carried upon a two-horse cart, from the harbours; and 150 to 200 stone of hay, tron weight, or from one and a half, to two loads English weight, is carried by each two-horse cart, to the towns of Perth and Dundee. By these means, the expence of conveyance has been materially di-

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hoped, that this measure will be taken up by the Highland Society of Scotland, or the Board of Agriculture.

minated, and the rent of land has of course been prodigiously advanced.

In another district, that of Clackmannanshire, the roads have also been much improved, by which the operations of the farmer have been greatly facilitated ; a greater proportion of work is performed at much less expence, the labour of the horses is much easier, a double quantity can be carried to mill and market, a greater quantity of manure conveyed, from the nearest town, or farm-yard, in a shorter period, and wear and tear of every sort greatly reduced. There is indeed no county in Scotland where the landed gentlemen have studied the improvement of their estates in this particular, more than in Clackmannanshire, both as to public and private roads ; and, of consequence, there is hardly a district in the kingdom so much improved in so short a period ; land which let ten years ago at 50s. will now average L. 5 *per* acre ; the farms in general are enlarged, much better cultivated, whilst the farmers are more comfortable ; and it seems to be the greatest pleasure that the proprietors can enjoy, to add to the happiness and comfort of their tenants, *by good roads*, convenient farm-house and offices, good fences, and leases of a proper duration.

Roads may be considered as of two descriptions : 1. Public roads, already touched upon ; and, 2. Private roads, to which none but the farmer and his servants have access. It is much to be lamented, that in several districts, where the great roads are attended to, the private ones should be neglected, yet they form as essential a part of the farm as the houses and fences, and, like them, should be made and repaired by stipulations between the landlord and tenant. There is nothing for which the latter can afford to pay a *per centage* better, than for a good road through his farm. Every farmer, therefore, ought to lay it down as a rule, completely to repair a certain extent of road each year, say

from fifty to five hundred yards, in proportion to the extent of his possession, and a stipulation to that effect might be no improper clause in his lease. The roads, even on a large farm, would thus be almost insensibly gone over, and its value would thus be materially increased.

It is impossible, however, that any improvement can be made on the roads of the kingdom, unless broad wheels are adopted; and it will appear from the following communications, that they are as well calculated for farming, as for other purposes.

The Honourable Baron Hepburn informs me, that broad wheels are now introduced into East-Lothian, and that their use is spreading fast in that district, though the husbandry servants, like their brethren in other counties, are much attached to ancient habits and usages, and averse to the introduction of new improvements. The Baron first used them for drawing turnips, and leading off stones from new-sown cut grass, but he had lately occasion to send his carts for some flags from the sea-shore, and as these flags were heavy and unwieldy, all his carts, including his broad-wheeled ones, were sent, to give a sufficient power of men to load them; and as the road up the beach was steep, and through a dry and deep sand, it required three horses to bring up each cart to the top of that beach, although two horses brought the loaded cart home from that point. It was soon found, that the broad wheels rolled, and did not sink in the sand, and the loaded carts with broad wheels, were brought up with infinitely less fatigue or exertion to the horses. The servants immediately became converts to the utility and advantage of broad wheels, insomuch, that those who generally worked these broad-wheeled carts, resisted and reluctantly yielded the use of those carts to their fellow-servants, when ordered to use them in carrying potatoes from the field. The result was, that the Baron has

been obliged to purchase a pair of broad wheels for each of his carts.

The Baron adds, he has no doubt that broad wheels will gradually creep into general use among the wealthy husbandmen, but a statutory enactment may be necessary to compel carriers of every description, (a numerous class), to adopt them, as broad wheels, by having more wood and iron, are rather more expensive. Five years, however, should be allowed to wear out the narrow wheels now in use. The sheriffs of counties should be directed, to be particularly attentive in regularly intimating these statutory enactments, the first year, the third and the fifth years, at their several commencements, as the above description of people, are generally very illiterate, and, indeed, inattentive to statutory enactments of any kind, as very few ever reach them, or awake their attention.

An eminent agriculturist on the borders, Mr Walker of Wooden, is of opinion, that if broad wheels could be brought into general use, it would be attended with a very great saving of expence upon the public roads; at any rate, he is convinced that they are on many occasions of much importance to the farmer. In wet seasons they are peculiarly useful in leading home the crop from wet or soft lands, which have been sown down with grass-seeds; in taking the stones from the same lands in the spring, when they are to be cut for hay; and in leading turnips off wet lands. On such grass lands, while the ordinary wheels sink very deep, and greatly injure the ensuing crop, wheels of only double the ordinary breadth, make almost no impression whatever. He always keeps, therefore, three or four pair of these wheels for the purposes above mentioned. They are made at hardly any additional expence. Each wheel is covered with two old iron rings of the common wheel, after they have become too thin for use upon the

road; and as the broad wheels are seldom used but upon soft ground, these old rings last a long time, and they are attended with no trouble or inconvenience, as they are made to fit the axle-tree of the common wheels.

But if it be possible, by any means, to impress the public mind with a deep conviction of the advantage of broad wheels, the following observations, from an intelligent and respectable country gentleman; William Cunningham, Esq. of Lainshaw, will probably have that effect. He states his full conviction, that no person whose mind is open to conviction, can make a trial of these wheels, *for farming purposes*, without at once perceiving their very great superiority over the old wheels. He is satisfied, that his farm roads will, in time coming, be maintained at one-fourth of the expence hitherto incurred for that purpose; and, as he is draining his own farm to an extent not yet practised in this part of the kingdom, which necessarily requires a proportionate carriage of materials, he expects very soon to be repaid the cost of his new wheels.

He informs me, that he got one pair of broad wheels in the month of May, 1811; and that after a very short experience of their effects upon the roads of his farm, he ordered three pair more to complete the regular establishment of his farm, which consists of four single-horse carts. His wheels are five inches broad, and four feet six inches in height. They cost, at Morton's manufacture, Leith Walk, near Edinburgh, about L.11, 18s. cash price. Common wheels of the same height, and about two inches and a half broad, cost, in Ayrshire, about L.8, 10s. Cylindrical wheels, he affirms, are equally well adapted *to every purpose*, whether of road, carriage, or agriculture. In farming operations, their superiority is so great, that he thinks it would be for the interest of every extensive farmer to adopt them immediately, even if he should be obliged to

break up, and burn his old narrow wheels. He does not think that they will do, where roads have been *deeply* rutted by old narrow wheels, unless great care is taken to avoid the ruts; but he is satisfied, that equal weights can be carried with them, and probably greater. They do not shake the horses on rough roads like the wheels with bent axles, and consequently are easier drawn. The weight of the wheels and axle is about 5 cwt. 32lb. Common wheels, with iron axles, weigh six or seven stones less. The body of the cart weighs 3 cwt. 16 lb. With these wheels, he carries about 15 cwt. in single-horse carts, but if the roads were without pulls, a greater weight might be taken. He is determined, that all his farm wheels shall be of that description; he considers them to be the greatest improvement in agricultural machinery, since the invention of the threshing-mill; and he conceives that every month's delay, that takes place in the general adoption of them, produces a great national loss.

Mr Morton states, that the broad cylindrical wheel, besides the advantages it possesses upon a good road, or causeway, is also more easily drawn over a new-metalled or gravelled road, than the common narrow wheel, in consequence of its having no tendency to remove, or disturb, the materials, having only the effect of levelling those stones which stand highest, and thereby rendering the whole more compact and smooth; whereas, the narrow wheel presses the stones it bears upon, aside, and thereby forms a rut, into which it sinks,—consequently increases the obstacles it has to encounter. He also observes, that a small additional weight to the wheels, (say one half cwt. *per* pair), is of much less consequence than the same additional load to the body of the cart.\*

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\* It is proper likewise to remark, that a cart with broad wheels goes

Perhaps the most striking fact in favour of the use of broad wheels is this, that the carts of the London and Edinburgh Shipping Company, have cylindrical wheels of five inches in breadth, and yet, with a single-horse cart, they frequently draw, (the weight of the cart and the wheels included), no less than forty cwt. or two tons, though there is a considerable ascent from Leith to Edinburgh, and the road in some places is not in the best state of repair. The Edinburgh and Leith Shipping Company use the same sort of wheels with equal success.

In regard to the encouragement that ought to be given to broad cylindrical wheels, Mr Cunningham is of opinion, that if cylindrical wheels were to come into general use, and were the toll rates much lessened in their favour, great inconveniences might result from the diminution of the revenues of the tolls, which are in many cases mortgaged, in security for sums advanced to make and repair the roads, and in other cases there are contracts in existence for maintaining the roads for a term of years.—It is obvious, that till the existing debts are paid, and the current contracts have expired, no general diminution of toll-rates can take place; but were these objects once attained, he thinks, that the roads might be kept up, by levying one-half, or one-third, of the tolls now exacted.

The advantages which the nation would derive, from a due attention to the important objects of roads and carriages, are not easily to be calculated.

Before the subject of roads is dismissed, it is necessary to observe, that in many districts, some plan should be

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more solid and regular, and with less agitation than with narrow wheels, and consequently the machine, as well as the horses and the roads, would last much longer, by which the expence of the additional original cost would be amply repaid.

adopted, for enforcing a more impartial distribution of the road-funds;\* and that, when new turnpike roads are formed, more care should be taken in the expenditure of the money laid out. No sum should be expended, nor any debt incurred, without accurately examining the ultimate expence, otherwise the whole funds will soon be exhausted, and the produce of the tolls will not clear the interest due by the trust. The business then becomes more and more troublesome to attend to, and the road is neglected.

It may be proper also to add, the substance of Mr London M'Adam's directions for repairing roads, extracted from a valuable communication, which I had the pleasure of receiving from him, regarding that interesting particular.

He is of opinion, that where there is a quantity of clear stone, equal to a foot thick, there is no occasion for any additional materials, when a road is to be repaired. The stones, to the depth of a foot, should be taken up, (one half of the road at a time, to prevent the communication from being interrupted), and then broken, so as to pass through a screen or harp, through which no stone, above an inch in any of its dimensions, can be admitted. The road should be laid as flat as possible; the less it is rounded the better, provided it is not hollow in the middle. The broken stone should be laid evenly on the road, on a coat of six inches at a time, that the materials may be consolidated. Any ruts,

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\* The management of turnpike trusts ought to be regulated by a general law, so as to prevent jobs. To carry a particular object, meetings are sometimes held in one district, while they ought to have been held in the other, and other manœuvres of a similar nature are perpetually going forward. Is it then to be wondered at, that roads should get into disrepair? Tenants paying a certain rent, should certainly be allowed to vote in the disposal of the county assessments, to which they contribute so much, and in the proper application of which they are so materially interested.

that may at first be formed, should be immediately filled up. Every road should be made of broken stone, without any mixture of earth, or any other matter; no large stones to be employed, on pretence of *bottoming*, nor sand, earth, or other matter, on pretence of *blinding*. A road made of stone, effectually broken, will have a smooth, hard, even surface, which cannot be much affected by the weather, and will be nearly equally good at all seasons of the year.

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#### SECT. VII.—*Instruments of Husbandry.*

IT is of peculiar importance, to adopt the best and most economical implements of husbandry, and in general, not to incur an unnecessary expence in purchasing them, nor to have more than are truly requisite. In these respects, the Scotch farmers furnish an example which ought to be generally followed; for the number of the implements they use, are not only few, but they are distinguished by the simplicity of their construction, their efficiency, and their cheapness. A farmer is thus enabled to do the same work, at less expence, and he can afford to pay more rent, without even raising more produce.

In treating of this subject, we shall consider the nature and construction of the following instruments: 1. Ploughs; 2. Harrows; 3. Carts; 4. Fanners, or winnowing machines; 5. The Threshing-mill; and, 6. Miscellaneous Articles.

1. PLOUGHS.—Ploughs with wheels are in general too complicated, and their weight so great, as to require an ad-

ditional horse, or pair of oxen, to pull them along. In Scotland, therefore, the swing-plough is almost universally adopted, and rarely more than two horses are now made use of. The horses also are yoked a-breast, by which the advantage of their full strength can best be obtained, animal power being most advantageously exerted, when employed separately, and close to the work. Indeed, when horses are yoked one before the other, or harnessed at length, it is hardly possible that they can pull equally. The power of the fore horses must be exerted, to reduce the traces to a straight line, which cannot be done without pressing on the back of the hindmost horse, where the angle is formed, and consequently greatly distressing him : hence the superiority of ploughs drawn by two horses a-breast, and of single-horse carts. In regard to the operation of ploughing, also, it is to be observed, that less time is lost in turning, more especially in small fields, insomuch, that with equal ease, two horses a-breast will do at least one-tenth more work, than the same horses will perform when placed in a line.

The plough generally used in Scotland, is known under the name of Small's plough. But in some of the western counties, as in Ayrshire, Renfrewshire, and Clydesdale, a plough made by Mr Wilkie of Uddington is very common, and much approved of.\* The same artist has lately introduced an iron plough.† In the neighbourhood of Jedburgh, Veitch's construction is justly celebrated, though the sources whence its merits are derived are disputed. But as James Small is the artist to whom hitherto Scotland has been most indebted, I propose, in the Appendix, to ex-

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\* See Aiton's Report of Ayrshire, p. 214.

† Ditto, Addenda, p. 723.

plain the origin, nature, and advantages of his improvements.

The ploughs in Scotland are now almost universally worked by horses; but some intelligent farmers on the borders, think it of advantage to have some ploughs worked by oxen also, as they are not so high-priced, and more cheaply maintained; they are of opinion, therefore, that any extraordinary stock, not constantly required, should be of that description.

For cleaning green crops, a double plough, which takes a furrow from each side of the row, is reckoned to be a great improvement, and if properly used, renders the mould as fine as that of a garden.

In general, the horses are yoked a-breast, and never in a line, excepting to take up the last furrow in a wet wheat seed-time, to prevent poaching.\*

In some parts of Scotland, it is necessary to have strong ploughs, calculated for breaking up marshy ground, or old ley, where furze perhaps may abound, and, in such cases, four horses are necessary; and farmers make it a rule, to have a spare plough or two, so that the horses may not be kept idle, in case one of the ploughs should accidentally break.

2. HARROWS.—The harrows used in Scotland are made partly of wood, and partly of iron; but of late, harrows have been made entirely of iron, which are reckoned far superior to the common sort, particularly when harrowing deep lands, as from the narrowness of the bulls or bars, the earth does not clog them.† The construction of harrows

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\* Communication from Mr Gray of Gorgiemoor.

† Communication from Mr Robert Hope of Fenton.

must depend on the nature of the soil. Those which are best calculated for strong clay, cannot be suited to light sands and loams. It is a general rule, however, that the teeth should be round, as they keep themselves cleaner than the square, or any other shape, and work easier after the horses.

3. CARTS.—It is a general rule with Scotch farmers, that every man-servant shall have a cart, a plough, and a set of harrows, for each pair of horses, so that whether the weather answers for carting, ploughing, or harrowing, the whole horses and servants are always employed.

Single-horse carts are, in general, preferred; but when the land is deep, the roads bad, the ascent great, or the load heavy, two horses are frequently made use of.\* A most intelligent farmer on the border observes, that when

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\* Some farmers think, that where six ploughs are kept, there ought to be twelve carts; though by having a cart for each horse, the expence of that article is increased, yet the waste of a cart that carries a ton, is greatly more than where only half that weight is carried. Two horses, however, must be occasionally used. The steady horse, in that case, should be put in the trams, and the spirited horse as leader, as he is apt to do more work than he should. Others are of opinion, that two carts for each pair of horses, are an unnecessary expence upon an extensive scale of farming; and, in particular, that at a distance from large towns twelve carts are quite sufficient for twenty horses, in all the operations of the farm. In winter, horses can be changed forenoon and afternoon, by being wrought in single carts, and the horses are the better occasionally of easy work. But it is proper that each horse should have a cart-saddle to fit his back, and that each man take care of his own harness. It is much the more correct plan, upon a great concern, that four or six men be entrusted with the delivery of all the grain. It is needless, therefore, to give each man the charge of two carts; for though no requisite outlay on a farm ought to be withheld, yet no requisite expence ought to be avoided.

two horses are yoked one after the other, unless the driver is very attentive, they seldom draw together, sometimes one drawing the whole, and sometimes the other. He has only used single carts for twelve or fourteen months; but, from the trial he has made, he is convinced, that two horses in single-horse carts, will, with equal ease to themselves, draw at least one-fourth more than in a double-horse cart when yoked one after the other. Another great advantage attends single-horse carts; the carters cannot run races when going for lime and coals, by which the horses are often rendered lame, and sometimes destroyed outright. This is a practice that too much prevails, notwithstanding the frequent punishments inflicted, and examples made, for that offence. It has been observed, indeed, that nothing can be said in favour of double-horse carts, (in nine cases out of ten,) that may not be as justly urged in favour of waggons and ploughs with four horses. It is a singular contrast to see the farmers of Ayrshire and Lanarkshire, carrying from 15 to 20 cwt., and sometimes a great deal more, in a one-horse cart, whilst in other districts, from attachment to old habits, two strong horses are employed, to bring a load of dung, not much heavier, from the dung-hill in the same field, to the turnip drill, even where there is little or no declivity, and where the additional horse must do damage to the ground in drills.

In summer, more especially, single-horse carts are preferred by intelligent farmers, as the roads are then good, and the horses will bring home more lime to the farm, or carry more produce to market, in two carts than one. By dividing the load also, both carts and harness will last much longer. What weighs much with many sensible men is, their observing that the people who drive their own horses, always yoke them in single-horse carts. Others contend, that though persons driving their own horses, with great care, may adopt such a plan, that is no reason why the same sys-

tem should be adopted by the farmer, who must trust his horses to the discretion of every common servant. They admit, that coal and lime, and grain to the market, may be advantageously driven, on good and level roads, by single-horse carts; but they affirm, that they cannot be depended on for leading home the crop, nor for carrying out the dung, as the wheels will sink in pulverised fallows, or turnip land, even if dry, and still more so after rain.

If, however, two horses are to be used, (though after a full trial there is every reason to believe that single-horse carts would be found more effective, and less injurious to the horses), curriole-carts, or yoking horses a-breast, might be tried, more especially where the roads are broad, so as to quarter with ease: In that way, both horses can employ their whole strength, and it is a likely mode of making a powerful and effective draught.\*

In time of harvest, the common box or cart is removed from the axle and wheels, and large frames are put thereon, for the purpose of bringing home the crops of hay or corn from the fields, or for carrying hay or straw to market. Indeed, where the carriage of hay or straw is to a distance, two long carts are sometimes kept, made uncommonly strong, and stayed with iron bars.

In regard to waggons, there are not above six in the whole kingdom of Scotland. In the words of an intelligent farmer, this cumbrous and expensive machine is but little esteemed, and hardly any where to be met with. Every

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\* Mr Wilson of Simprin states, that horses going a-breast, were tried in his neighbourhood twenty years ago, and did not answer; the horses fought, or jammed upon one another. He also tried them in a roller, and it had the same effect. But this might have been owing to mismanagement. The cart ought to have only a pole, as in a coach or curriole, which would obviate the difficulty.

farmer is now thoroughly convinced, that the cart in common use, answers every agricultural purpose infinitely better.

4. FANNERS, or the *Winnowing Machine*.\*—This excellent instrument is more generally to be found in Scotland than even the threshing-mill. By using it, with the aid of riddles in some part of the operation, all dust, chaff, and other refuse are blown away, and the grain separated into divisions according to its quality, by which it is rendered intrinsically more valuable, than if the good and the bad were mixed together; in the same manner, as a fleece of wool is more valuable, when broken or sorted by the wool-stapler.† The threshing-mill has generally one set of fan-

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\* Mr George Culley thought, that those implements should not be called Fanners, but *winnowing machines*, because the fanners with sails, properly so called, are used in the midland counties, and in many parts of England, where these truly valuable machines, so universal in the northern parts of the kingdom, are scarcely known to many farmers in the south. It is a singular anecdote, worth preserving, as proving the difficulty in the introduction of new improvements, that, about the year 1765, a friend of Mr Culley's sent a winnowing machine to Mr Bakewell, at that great man's request. Two or three years afterwards, Mr Culley happened to accompany that friend to Dishley, where they observed them dressing barley with their own kind of fanners. On being asked, what had become of the winnowing machine, one of them pointed to the roof of the immense barn, where it was suspended as a useless implement. Even that wonderful persevering man, was not able to overcome the prejudices of his servants of that period. Mr Culley states, that it was about the year 1752, that he first got a winnowing machine, all the way from Hawick to Denton, long before he came to Northumberland, from Mr Rogers, ancestor to the person who still makes very good ones at Hawick, in Selkirkshire, and whose ancestors were the first that manufactured them in Britain.

† There is an excellent account of the fanning or winnowing process in Kerr's Berwickshire. It is said that the machine was invented by Dr

ners attached to it, driven by a belt from the end of the axle of the threshing drum; but where the machine is driven by horses, the working of a second pair, for cleaning the grain completely, is rather found to be severe upon them: the second pair of fanners is therefore generally driven by hand. Some recommend a small water-wheel, totally unconnected with the threshing machinery, for driving the second fanner, which, by affording a steady equable motion, would separate completely the light grain from the heavy.\* By some improvements in the late-erected machinery, it is said, that hand-fanners are rendered unnecessary, and that the cleaning of the grain is completed, at the same time that it is threshed, so that the grain may be measured into the sacks. This would indeed be an essential improvement. At the same time, owing to the inequality of motion necessarily attendant on the operation of threshing, the second fanner, for separating the light grain from the good, will not accomplish the purpose intended, in a perfect manner, if it goes at the same time with the mill. Perhaps it would be expedient, that the threshing and fanning processes should go at different times, when horses are employed, at least in threshing of wheat.

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Papin, was introduced by the Dutch into the barn, and brought to Scotland by Meikle, the father of the inventor of the threshing machine. Others contend, that the idea originated in China, though it has been greatly improved since its introduction into this country.

\* Mr Cuthbertson finds, that the two pair of fanners attached to his water threshing-mill, perform their work so well, that oats or beans are completely finished for market; wheat and barley, however, require an additional dressing by the hand-fanners. The water, however, cannot be exclusively employed for the winnowing process, unless when it is abundant.

5. THE THRESHING-MILL.—But the great glory of the Scotch instruments of husbandry is “the threshing-mill,” by means of which, these important operations, the separation of the grain from the straw, and in some measure the cleaning of it afterwards, have been carried to a degree of perfection and extent in Scotland, altogether unrivalled in any other country.\* There is no doubt, that many attempts had been made, at various times, for constructing machines competent to the task of threshing; but I am fully convinced, that had it not been for the superior ingenuity of Andrew Meikle, no threshing-mill would have been brought to any high degree of perfection in our time. To him may be justly attributed the merit of the feeding-rollers, and the drum; the plan of the flax-mill having been adopted in other cases. Every friend to merit, must rejoice to hear, that the inventor of so important a machine, was rendered comfortable in his old age, and enabled to provide for his family after his death, by the voluntary donations of his grateful countrymen.†

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\* As a proof of the great number of threshing-mills and fanners erected in Scotland, I am informed, that in the Carse of Gowrie district alone, which is a tract of about fourteen miles long and four miles broad, there are no less than 120 threshing-mills driven by horses, and ten by water. In other parts of Scotland, threshing-mills are so general, that it is very difficult to find a man who will thresh with the flail. A mill-wright also has now become a separate trade or occupation from other branches of mechanism, in places where that was not formerly the case.

† The history of the origin of the threshing-mill is very ably explained in the Farmer's Magazine, and in Brown's Treatise on Rural Affairs. It is certain that skutch mills had been previously invented, and mills of that description are capable of threshing oats, and barley. That, however, does not detract from the merits of Mr Meikle, whose mills are capable of threshing all sorts of grain, and particularly wheat, in a superior manner.

It is not intended, in this place, to give any description of the nature of the machinery; but it may be proper shortly to lay before the reader, 1. An account of the different powers used in driving the machine; 2. A short view of the advantages resulting from the invention; and, 3. Some hints regarding the improvements of which it is susceptible.

Threshing-mills are driven, 1. By horses; 2. By oxen; 3. By wind; 4. By wind or horses; 5. By water; 6. By water or horses; or, 7. By steam. Some small machines of this sort are driven by manual labour, which have of late been improved, but in general it is to be observed, that unless machines are of a strong and powerful construction, they are constantly going wrong, and require perpetual reparation.\*

1. Where a command of water cannot be obtained, which is certainly the least expensive power that can be employed, *horses* are commonly made use of; and when the farms are of a moderate size, and where the horses are rarely employed in that labour, some farmers are of opinion, that the exercise they receive is not prejudicial to their health. Indeed, as they are principally worked in bad weather, when other business out of doors could not be attempted, they consider the threshing by horses as attended with little or no expence; but where the crop is large, and in particular

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\* Mr Neil Ballingal states, that the advantage of a mill, strong and well constructed, well managed, and with fanners, is of the greatest importance. But a slight mill, constantly breaking, and with no fanners, no farmer would accept of as a present. At the same time, it is remarked by Mr Stewart of Hillside, that in moderate-sized farms in his neighbourhood, where the principal crop is oats, a smaller kind of threshing-mill, without fanners, will suffice, as the farmers find time in the evenings of winter and spring, to dress the corn by hand-fanners.

where a considerable proportion of it consists of wheat, and where the machine is heavy, the labour must be severe. This additional labour, however, where no other power can be applied, farmers consider to be indispensable; and may not be so destructive to horses, if the work is not made oppressive, merely for the sake of expedition.

Mr Blackie of Holydown, gives the following calculation of the number of horses required for the different crops. A four-horse mill he thinks is quite sufficient for oats or barley; but where there is much wheat, a six-horse power is required. A three-horse power does very well for potatoe-oats, when the corn is fed in by a careful hand; the mill then threshes much cleaner than a flail: But when the corn is put in faster than the mill is ready for it, the horses are oppressed, and the work is not well done. Mr Shirreff is of opinion, that a threshing-mill, of the power of six horses, will thresh the produce of 400 Scotch acres, all under corn crops, say 3000 bolls, in the space of only thirty weeks in the year, or at the rate of 100 bolls per week.

2. It is said that working threshing-mills by horses, is a power so unsteady, and attended with so much destruction to them, and hence so expensive, that some farmers still prefer the flail, to the erection and keeping up of the machinery and horses. Though such an idea is far from being general, yet it certainly would be desirable, to exempt the horses, regularly working on the farm, from so laborious a task, and oxen have been strongly recommended for that purpose.

A gentleman on the borders, who rents about L. 4000 *per annum*, informs me, that before he had collected water sufficient to thresh his crop, (which may be done much oftener than people are commonly aware of), he was accustomed, for many years, to thresh his crop by oxen; and he

adds, that wherever there is a necessity for using animal power, he would recommend oxen, as they are more steady in the machine than horses. His oxen, when employed in the threshing-mill, were fed in the usual way; only from being so near the shed, or court, they were unyoked in the middle of the day in winter, and got a few turnips, in lieu of the hay they were accustomed to get at mid-day, when employed in the field. A piece of wood was fixed to the beam, or what is commonly called the start of the mill, and the oxen were yoked to it by chains, in the same way as in the plough. For six or seven years, he never had a horse in the mill, and each ox was employed nearly three years, one out of three being annually selected for feeding, and a young one trained in its place. When not employed in the threshing-mill, the oxen ploughed or harrowed as usual, and sometimes were employed in carting dung, turnips, &c.

The advantages of using oxen in threshing-mills, are represented in the strongest point of view by Mr Wood, late of Mill-Rig in Linlithgowshire.

In a communication to a useful institution, the Salton Agricultural Society, he observes, that threshing-machines are so much connected with the farming business, that it cannot be carried on without them. They are in general drawn by horses, and are found to be very injurious to that valuable animal; for which reason, he advertised some time ago, to have one made, to be driven by oxen, so as to suit their natural step. This he happily effected. For two seasons he threshed with oxen, and found, upon trial, both the mill and oxen to answer particularly well. It was thus in his power to have his threshing carried on, without interrupting any work wherein his horses are engaged, besides exempting them from the severe labour of threshing about 100 acres of wheat annually, which proved destruc-

tive to his horses, though they were very high fed.\* The use of oxen, therefore, in this operation, may certainly be looked upon, in some degree, as an improvement in agriculture. It is but fair to add, that for the first four or five times, the oxen are very awkward in the mill, and great care is then necessary to teach them; but after that, they go more steadily than horses. When once a mill also, is constructed for the slow motion of oxen, which must go with more velocity on account of the slower pace of the ox than of the horse, it is necessary to employ oxen constantly for the sake of the machinery.

Mr Andrew Gray makes the following observations on this interesting subject. Some persons are of opinion, that as oxen in general move very slow, hence much time and labour would be lost in working them. That, however, can be obviated, by altering the velocity of the machine. It is also doubted whether oxen are as well adapted as horses for walking in a circle. A farmer in the county of Moray, however, informs me, that he has used four oxen in a threshing-mill, at one of his farms, and that he found they did equally well as horses; by which his plough-horses were relieved, and the oxen he worked, were kept in good condition, by turnips and straw: and as it has been found

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\* It is said, that on the greatest part of farms, hands for threshing cannot be got, independent of the ploughmen; the exemption of horses, therefore, is an object of less consequence. Labourers, however, may be hired, and in bad weather, the horses will be refreshed by rest, and will not require to be so highly fed. Besides, on all large farms, there are spade-men and others, who may work at the threshing-mill; and where there are water-mills, it is not unusual to have a distinct set of hands, who soon acquire more expertness, than ploughmen or others, who can only be occasionally employed. It is an invariable rule with all good farmers, never to separate the ploughman from his horses, when the weather will allow him to work with them.

from long experience, that oxen, if properly trained, will work equally fair and pleasant with horses, either in the plough, the wain, or any other machine in which they move straight forwards,\* it may therefore be presumed, that if taught, they will work equally fair when walking in the same circle, and though oxen in general move slower than horses, the threshing-machine can easily be so calculated, as to answer with their slower pace. It would therefore seem, that oxen are at least equal, if not superior to horses, for working threshing-machines.

These are considerations which merit well the attention of every farmer in the kingdom, more especially as the price of horses is constantly increasing, and as it can hardly now be doubted, that for working in the threshing-mills, and other extra labour, a few oxen on a farm might be attended with infinite advantage.

3. The next power is *wind*; and if water cannot be got, it is contended, that a wind-mill is greatly superior to one wrought by horses. Wind-mills are now so nicely constructed, that the sails contract and dilate, according as the wind increases or decreases; so that now the motion is much more uniform than that of a horse-mill driven by the most careful driver. The next great advantage of the wind-mill is its great power, which permits more work to be done in the same time, and at less expence; as the ordinary servants on the farm, if the wind is favourable, may thresh a

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\* Horses will carry as well as draw; hence some of the load may be put on their back, and the horse is the better for it, more especially going up hill. Oxen, on the other hand, will draw, but cannot carry; tumbril carts, therefore, having three wheels, are the best for them. If oxen are apt to be giddy in a threshing machine, they should be blind-folded, as horses sometimes are. Giddiness may be occasioned by the smallness of the diameter of the course.

sufficient quantity, after having finished their daily labour at either cart or plough; besides, the expence of tear and wear of horses employed at the threshing-mill is very great, as no work upon the farm is half so expensive.\* Mr Rennie of Oxwell Mains considers, that a wind threshing-mill, equal to the power of eight horses, will annually save, when compared to horses, besides the saving that would be made by the horses, L. 40 *per annum*, deducting the sinking of L. 200 additional expence, in the erection of the machine; and Mr Wilson of Simprin in Berwickshire is of opinion, that wherever a great quantity of wheat is grown, the resistance is so great, and to overcome it is so destructive to horses, that a threshing-mill ought to be driven either by wind or water.

Others object to wind machines, on account of the expence of the construction, the certainty of their not going in calm weather, and the danger attending them when the wind blows hard. Mr Brodie of Garwald, in particular, observes, that in hilly situations, the wind is apt to rise in such sudden squalls, as frequently to make that power inconvenient, and not unaccompanied by danger.

Mr Neil of Kelso informs me, that the expence of a good wind threshing-mill will be about L. 550, and that when a horse power is annexed to it, the additional expence, according to the present price of timber, will be about L. 120 more, or L. 670 in all.

4. Aware of these objections to the power of wind alone, Mr Rennie of Phantassie, Mr Brown of Markle, and other respectable farmers, have erected threshing-machines, so constructed, as to be worked either *by wind or by horses*, as may be found necessary. They consider the power of wind

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\* Communication from Mr Rennie of Kinblethmont.

to be so uncertain, that without the addition of horses, a great inconvenience would often be sustained. Mr Hume of East Barns has a machine of the same description, but owing to the vicinity of the sea, he has hardly ever had occasion for the horse power. He considers a threshing-machine of great advantage, even with horses; but when wind or water can be obtained, it is worth, he states, on a farm of about 250 Scotch, or 316 English acres of arable land, from L. 100 to L. 200 *per annum*.

5. *Water* is by far the cheapest and the best power to be applied to threshing-mills. From the equality and the gentleness of the motion, the machine will last twice as long as one drawn by horses; and as water-mills generally do much more work when in motion, they do not require to be so frequently used. It is calculated, that in threshing a crop of any extent, a pair of horses may be saved upon the farm, by the use of a water-mill, which cannot be calculated at less than L. 100 *per annum*.

Mr Stewart of Hillside has a threshing-mill driven by water, collected from the springs in the upper part of his farm, and gathered in a dam. It has seldom been stopt for want of water, and then only in extreme frosts, when the ploughmen thresh, having little other work to do. Mr Stewart adds, that the barley is cleared of *awns*, by putting it through the mill with a grater upon it, which is done at the rate of three bushels in the minute. This seems to be a useful appendage to the threshing-mill.

6. Mr Hunter of Tynefield, and many other farmers in the improved districts of Scotland, have threshing-mills wrought *by water, or by horses*, when the water is scarce. About half Mr Hunter's crop is threshed by the water, which saves about 10 *per cent.* on the expence, whereas, by the labour of horses only, about 5 *per cent.* is gained. I consider this to be a very useful suggestion. There are many

situations, where, by collecting springs, and forming dams, half the labour of threshing might be done by water, without much additional expence of machinery.

7. The last power that has been lately applied for the purpose of impelling threshing-machines is *steam*, and there is one of these machines in East Lothian. It is said, that on some new plan, steam-engines have been invented at Hull, which would cost about L.200, which would furnish power sufficient to drive a threshing-machine.\* But there has not hitherto been sufficient experience, to determine the comparative advantages and disadvantages of the plan. It is said that 12 cwt. of coals are required to thresh 50 Berwickshire bolls, or 300 bushels of wheat. It is probable, however, that the alternation of heating and cooling the steam apparatus, may occasion much loss and expence in repairing the furnace and boiler; and there is little chance, in districts merely rural, of being readily able to procure work-people, who are sufficiently conversant in steam-engines, for keeping the valves, leathers, and other parts of such nice machinery in order. Where coal can be had at a moderate expence, some would reckon steam superior even to water; but as fire is always a dangerous enemy to straw, and farm-servants often careless, it may sometimes be attended with risk. It is a great advantage attending the use of steam or water, or even wind, that an apparatus, for cutting straw, and bruising oats, may be attached to them.

In regard to the expence of a threshing-mill, *to go by steam*, the following is the cost of one, erected by a respectable farmer on the border, (Mr Thompson of Chillingham Barns), communicated to me by Mr Bailey, as it is desirable that those, who propose having threshing-

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\* Communication from Mr Brown of Cononsyth.

mills, should be able to compare the expence attending the different sorts.

Expence of the engine and house,	-	L.325	0	0
The threshing part,	-	-	100	0
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		Total,	L.425	0

The drum and rollers are six feet long each. It has two rakes, and two winnowing machines: The quantity of coals sufficient to keep the engine going six hours, is from 20 to 24 bushels; the work performed is from 1000 to 1200 sheaves *per* hour.

It requires one man to attend the engine, in addition to those usually employed, where water or wind is the power. The expence of coals will vary according to circumstances; in this instance, 24 bushels cost about 10s.

This engine was calculated to be equal to a five-horse power, but will do more business than six horses, which, requiring a driver, will balance the man attending the engine, and of course the difference of daily expence, will be between the value of 24 bushels of coals, and the labour of six horses.

Mr Thompson's machine was made by a steam-engine maker at Newcastle, and any steam-engine wright can make them. There is little difficulty in managing them, no more than for a colliery, and Mr Bailey thinks, much less than those driven by wind. Steam also is a much steadier, and a more certain power than wind or horses. The annual expence of repairs, it is supposed, will be nearly the same, at any rate will not much exceed that of a wind machine. I am informed, however, that a greater quantity of oil and grease is required for a steam-machine, than any other.

In regard to horse machines, Mr Brown of Markle calculates, that a six-horse machine will, in two days *per week*, thresh the produce of 600 Scotch or 762 English acres, whatever the nature of the grain may be; but if the crops are either oats or barley, or the wheat straw short, the produce of 700 Scotch, or 890 English acres, may be threshed, and dressed for market, by such a machine.

It is observed, that where threshing-machines are wrought by horses, and only the same number of horses kept as before the erection of the mill, it will be necessary to give the work-horses hay instead of straw; as the mill generally occasions additional labour to the horses, perhaps for five months in winter, to the amount of from one-sixth to one-eighth more.

Threshing-mills, having the drum or cylinder driven by a strap, were constructed by a Mr Cotterel on Leith Walk, about the year 1788, or 1790; but in a few years they disappeared, as will others of the same construction, a strap being found inefficient to drive the nave of a threshing-mill.

On the whole, the remarks made by Mr Kerr, on these various powers, seem to be just. The greatest objection to horse machines, he observes, is the severity of labour which they require, besides often necessarily occupying the time of the farm-horses, when much wanted for other purposes. The capital defect of the threshing-mills which are driven by wind, is the extreme uncertainty of that power. During the long-continued frosts of winter, when there is hardly any wind, they are often altogether useless for weeks, when straw for litter and fodder cannot be dispensed with; and the same thing sometimes happens during harvest, when straw is much wanted for thatch.\*

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\* Wind-mills also, are sometimes apt to have their arms broken by

Water-mills, where that power can be had, are certainly the best in every respect; being more economical and steadier in their operation, than when driven either by horses or wind. But water is very apt to fail in autumn, and during long frosts, unless where care is taken, to have the water-wheel under the cover of a house. On these accounts, both wind and water machines, except when the latter have an ample and regular supply of the moving power, ought to be provided with horse-wheels.

*Advantages of Threshing-Mills.*—It is impossible to form, an adequate idea, of the advantages which have been derived from this important invention, without considering the manner in which threshing had been previously performed. There were two methods adopted for that purpose. The first was by a person who contracted to thresh the grain, giving twenty-four parts to the farmer, and reserving one twenty-fifth part to himself: the second method was, to hire a man to thresh the grain, at 1s. 3d. *per* boll. Both these modes evidently furnished an inducement to thresh the grain in a slovenly, rather than in a perfect manner; for the more labour that was bestowed on the threshing, the less was the profit derived from it. The mischief was, that by these methods, every part of the business was a distinct process. In the first place, as many

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high winds, more especially when entrusted to the management of persons not intimately conversant with their nature, and the mode of working them. This has given rise to so much trouble, disappointment, and expence, that some farmers in Berwickshire are tired of wind-mills, and propose returning to horse-wheels in their stead. As wind-mills are so common both in England and Holland, this must be owing to some defect in the construction, to mismanagement. or to higher winds being more prevalent in Scotland than in those countries.

hands were collected to bring in the stack, and to build it into one end of the barn, as would, with the advantage of a mill, bring in, thresh, and clean the one half of it, in the same time; next, the tasker, (or thresher who worked by tasked work), had to take it from the heap, (as it is called), to lay it on the floor, to shake it well, and then to thresh it; and when each floor is threshed, he must put the straw out of his way; twice every day at least, he had to gather what corn he had threshed from every corner of the barn, and to separate it distinctly from the straw; women had to attend twice a-day to shake the straw, and men to carry it away; and, last of all, hands were collected to clean and prepare it for market, after lying perhaps fourteen days on a cold clay floor. Instead of all this, with the mill, and at most nine hands, often with only six or seven, and from four to six horses, the farmer can bring in, thresh, and partly clean, on an average, twenty-four bolls in four hours, at the same time, shaking and disposing of the straw; and in the course of a few hours, the grain may be ready for the market, the door locked, and the key in his possession. What a difference, instead of being a sort of slave to taskers, for at least nine months in the year! A baker also, will, in general, give 2s. *per* boll more for wheat threshed by a mill, than by the flail.\*

The specific advantages resulting from this invention may be thus stated: 1. The threshing and shaking are so much better performed than they were by the flail, and by the hand, as to justify the opinion, that there is an advantage derived, equal to one boll in twenty, over the old-fashioned methods.† The quantity of grain left in

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\* Communication from Mr Richard Somner of Gilchriston.

† Communication from Mr George Farme, Braidwood, near Dalkeith, and Mr Brown of Cononsyth.

the straw by the flail, was formerly so great, that a respectable farmer in the Carse of Gowrie calculates, that, to his certain knowledge, it was equal to the expence of keeping all the work-horses on his farm,\* and the loss was so insufferable, that the farmer was afraid to go from home, for the eight months in the year during which the threshing lasted.† It is not only of importance, its being done in a much more perfect manner, but also, that it can be executed much more expeditiously,‡ in so much, that advantage may be taken of any sudden demand; a scarce market may be supplied; a stack of from 30 to 40 bolls may with ease be threshed in a day, and sent to market, or to the miller; and all this may be done, during weather when the other farming operations must be at a stand. 3. It has been well observed by Mr Brown of Markle, that if in the large farms of East Lothian, hand labour were to be used for separating corn from

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\* There is now no risk from foul threshing, as every farmer can distinguish, in a few minutes, whether the work is properly done or not; but by the flail, he was almost always at the mercy of the thresher, who grew so weary of so tedious an employment, that it is not to be wondered at he should execute it in a slovenly manner. Besides, the labour was an unwholesome employment, from the dust it was apt to raise, and those who worked at it seldom lived long. In short, numbers of the farm servants were, in former times, actually destroyed, by working in the barns.

† A tasker (thresher) being once severely threatened for *foul threshing*, very calmly answered, "I'm sure ye'l nae find hail sheaves among the strae,"—a poor consolation to the unfortunate farmer, whose interests were thus so deeply affected.

‡ Once putting it through the hand-fanners, completes it either for the mill, or the merchant, and a stack can be threshed out, cleaned, sacked, delivered, and might almost be ground, and baked into bread, in one and the same day.

the straw, a farmer's whole attention would be taken up by barn-work, otherwise the work would be imperfectly executed; whilst much pilfering would go on, unless he was constantly on the watch.\* At a threshing-machine, any thing of that kind can rarely happen, so many people being employed together when the machine is at work, constantly under the eye of the master, or of some confidential servant; and when the work is finished, every door is instantly locked. 4. One important advantage attending the threshing-machine, worked by any power, is the superior value of the grain; as the speedy way in which the work is executed, prevents that waste and damp, which was produced from the long continuance of the corn among the chaff, thereby rendering it not so fit for meeting the market, and of inferior quality to the consumer.† Hence, as Mr John Shirreff well observes, the corn, instead of lying during one, two, or even three weeks, amidst the chaff and other rubbish, in the corner of a barn, till it becomes quite raw to the touch, and musty to the smell, or, if the floor is damp, sometimes in part springs, grain, when threshed by the machine, is instantaneously separated from both straw and chaff, as well as every other extraneous substance, and can be immediate-

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\* The doors of the barns formerly were almost constantly open.

† Communication by Mr James Cuthbertson. Mr Peter Jack of Moncur observes, that when grain was threshed by the flail, it lay for ten or twelve days on the floor. The first part of the grain lying on the floor so long, became damp and swelled, that though put to a proper granary, yet it soon became musty, from the damp that it carried from the cold floor, and on that account never had the fine flavour in flour, that meal of all kinds now has, never being suffered to lie on the barn floor. North country oats and meal, often lose a market in the south, on account of the musty taste it is so apt to imbibe from damp floors.

ly measured up into bags, to be disposed of as may best suit the owner's interest. So great is the difference between grain threshed by the flail and the machine, that any person acquainted with the article, may go through a corn-market, blindfolded, and note every bag. This I am assured by several intelligent farmers cannot be questioned.

5. Another great advantage is, that the farmer can thresh his seed-wheat when in a soft state, recently cut and taken off the field, and without any injury whatever,\* which, before the invention of mills, it was hardly possible to get executed, in the harvest time, without the greatest difficulty, and at a heavy loss. He is thus also enabled to provide seed-corn in the spring, which formerly was not always an easy operation. When threshing for seed was done in a hurry, it may easily be supposed, in how slovenly a manner the operation would be performed. In the busiest time of harvest also, straw can be got for covering stacks, which formerly could hardly be obtained. 6. It is found that strong wheat-straw, is more useful for cattle, when threshed in a mill, it is so much more softened than by the flail.† 7. If a stack of corn is brought from the field into the yard too soon, and is heated, it is threshed in one day, goes to

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\* On the same system corn might be threshed in hazardous seasons, as soon as reaped, and either immediately kiln-dried, or frequently dressed by fanners, attached to a threshing-mill; and I am informed that this has frequently been done by active farmers. An ingenious mechanic has suggested a plan of drying corn by means of a metal cylinder inclosed in a case of brick work, which would occupy but a very small space, and might be put up at a small expence. The cylinder, he proposed, should be put in motion by a power from the threshing-mill. The grain was to be moved through it on a similar principle to the working of a screw. The principal heat to be applied to the end at which the damp grain entered. From two to three bolls *per* hour might thus be dried.

† Communication from Mr Peter Jack of Moncur.

the kiln and suffers no loss; but before the invention of mills, when threshed by the flail, it was so soured, that it was almost unsaleable, and a loss of perhaps 20 *per cent.* was thereby sustained. 8. It is observed by Mr Kerr, that smut balls are not so apt to be crushed by the threshing-mill as by the flail, and that the grain is consequently less apt to be blackened.\* 9. Mr John Shirreff remarks, that by the threshing-mill, the separation of the grain from the straw is not only more complete, than by any other known means, but the separation of the straw from the grain and the chaff, by the rake, and of the chaff and small seeds from the grain by the fanners and skreens, all driven by the same machinery, are advantages not inferior, perhaps, to the separation of the grain from the straw in the first instance. Taking all these circumstances into consideration, and that prior to the invention of threshing-mills, drudgery, it may be said, stared the farmer in the face; and that, besides heavy losses, it was the source of endless trouble and vexation to every occupier of land, it is not to be wondered at, that the threshing-mill should be considered the most useful and profitable instrument belonging to a farm, *and that its advantages should be accounted INCALCULABLE.*

Some estimates, however, have been made of the specific advantages to be derived from this invention, which one farmer calculates at the rate of 5s. *per acre*† on lands under crops of grain, whilst others state it 5s. *per acre* with horse-mills, but at full 10s. *per acre* upon the whole lands under crop, when the machine is driven by water, by wind, or by oxen.‡ Mr Dudgeon, Primrose Hill, from general observation, without entering into minute calculations, is of

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\* Berwickshire Report, p. 231.

† Communication from Mr Charles Alexander of Easter Haprew.

‡ Communication from Mr Wood of Milrig.

opinion, that the aggregate advantage derived from a well-constructed threshing-mill, wrought by water, and under proper management, (when compared with the old mode of threshing), will be about 8 *per cent.* upon the corn threshed, including labour alone, but without making any allowance for money sunk in erecting the mill, or repairing the machinery. It is calculated by an intelligent farmer, that a threshing-mill saves, on an average, the expence of three men for nine months, which, on a farm producing 1000 bolls, is equal to about L.70, or 1 s. 3d. *per boll.* Mr Dudgeon, Prora, has made a comparative estimate of the expence of threshing wheat by the mill and the flail; from which it appears, that the saving of charges in threshing alone, independent of other advantages, though the work be performed by horses, and not by any cheaper power, is equal to 47 s. *per 50 bolls*, or 11 d. *per boll*, increasing with the prices of grain. Mr Robert Kerr gives the following estimate of the expence of threshing and dressing 50 bolls of wheat :

Three pair of horses, at 6 s. <i>per pair</i> ,	-	L.0	18	0
Four men, at 2 s. 6 d. each,	-	-	0	10
Four women, at 1 s. each,	-	-	0	4
			<hr/>	
			L.1	12
Incidents, as oil, &c.	-	-	0	0
			<hr/>	
			L.1	12
				3½

Which is at the rate of 7¼ d. *per boll.*

In the wind or water-machine, the expence of the horses is saved, by which the cost *per boll* is reduced to less than 3½ d. By means of the steam power, the cost is restored to nearly the same with horses.

As to threshing by the flail, it was so irksome a task, that as labourers became scarce, the expence would have so much increased, as greatly to have diminished the profit of the farmer, and consequently the value of land.\*

Mr Brown, Markle, in his valuable Treatise on Rural Affairs, has drawn up the following estimate of the profit that might be derived by the public, from the universal adoption of threshing-mills. He calculates,

1. The number of acres producing grain in Great Britain, at	- - -	8 millions.
2. The average produce in quarters at 3 quarters <i>per</i> acre, at	- - -	24 millions.
3. The increased quantity of grain produced by threshing, instead of using the flail, at one-twentieth part of the produce, or in quarters at	- - - -	1,200,000
4. The value of that increased quantity at 40 s. <i>per</i> quarter,	- - -	L.2,400,000
5. The saving in the expence of labour, at 1 s. <i>per</i> quarter,	- - -	1,200,000
6. The total possible profit <i>per annum</i> to be obtained, at	- - -	3,600,000
7. The actual profit, on the supposition that only one-half of the grain produced, were threshed <i>per annum</i> at	- -	1,800,000

Is it then to be wondered at, that he should pronounce the threshing-mill to be the most valuable implement in the farmer's possession; contending, that it adds more to the produce of the country than any invention hitherto de-

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\* Brown's Treatise on Rural Affairs, vol. i, p. 315.

vised; and that it ought to be accounted the greatest improvement that has been introduced into Great Britain during the present age?

It is to be lamented, however, that the process of threshing by the mill cannot be carried on to the same advantage, unless where the ears are regularly exposed to the stroke of the beaters; reaping by the sickle, therefore, is much to be preferred; at the same time, if the grain is passed twice through the mill, it will be threshed effectually, in whatever mode it may be reaped, though at an additional expence.

*Improvements in the Threshing-mill.*—It is probable that several improvements will still be made on this machine.\* Amongst these, diminishing the size of the drum is certainly amongst the most important. The drum should not exceed from two feet eight inches to three feet, or three feet and a quarter in diameter. Mr Sked, mill-wright at Dunbar, has made a machine of six-horse power, with a drum of only three feet and a half long, and three feet and a quarter diameter. This machine, which has a large outer

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\* Mr Robert Kerr states, that Mr Dun, a very ingenious mill-wright, at Coldstream, in Berwickshire, has made many useful improvements on threshing-mills, in particular on those which go by wind; more especially by causing the machinery to regulate the sails in proportion to the wind and work, in a most effective manner, with no trouble whatever to the people who feed the mill. He has likewise adapted a series of buckets, resembling the chain-pump, which continually return all ill-threshed grain, particularly ill-dressed barley, to the threshing stage; and has, besides, added an ingeniously-devised shaker, beyond the rake, for clearing all the loose grain from among the straw. On the whole, the machines erected by Mr Dun have been carried to very great perfection; always supposing, however, that they possess sufficient moving power of water or wind; for they are rather too much loaded to be driven with any tolerable ease by horses.

wheel, threshes with uncommon ease, and very clean, and with so small a drum it can thresh from 10 to 12 bolls of wheat in an hour, whilst the horses are so cool, that they can be watered with safety after working five hours. That able mechanic, Mr Andrew Gray, is decidedly of opinion, that a small drum, with few beaters, is preferable to the larger one with a great number, the small drum making better work, not being so severe on the cattle, and less straining to the machinery. Although it is obvious that a drum, three feet diameter, having four beaters, must take two revolutions, for one of the drum six feet diameter, with eight beaters, it is evident, that the circumference of the one, will move nearly at the same rate as the other, because one turn of the large drum, is equal to two turns of the small one, they will give therefore an equal number of strokes in the same time; but it is found by experience, that the small drum threshes much cleaner, or makes better work, than the larger one. The small drum is therefore to be preferred; being easier driven, it must be less severe on the cattle, and by its striking the corn at a more acute angle, of course strips off the grain much cleaner from the straw.\*

Another improvement is, instead of two fluted rollers, to have one of them plain, but chipt cross-wise, about half an inch deep in various places. This prevents the straw from

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\* Mr Wood of Milrig remarks, that he has always found the moderate-sized threshing-mill, if all the parts are made substantially, by far the most useful, and less destructive to the animals which drive it, and sufficiently expeditious for the purpose of any farm; and by employing a certain number of day-labourers, which a farm of proper size has always at command, and by employing oxen for threshing; the horses, and the men who work them, are never taken from other agricultural purposes, very necessary perhaps to be carrying on at the same time.

rolling round the fluted roller; in which case the straw must be immediately cut, otherwise much mischief may be done. This is supposed to be a Scotch invention, for it was only introduced into Northumberland in the year 1807. When chipped, the straw adheres to the roller, without rolling or lapping round it, which it is apt to do, when the roller is fluted, if the straw is damp. On this subject, however, there is a great diversity of opinion. One respectable correspondent affirms, that a plain roller, instead of being an improvement, is, on the contrary, detrimental to the work; fluted rollers being, in his opinion, necessary to retain the corn for a length of time sufficient to thresh it. Another intelligent farmer, on the other hand, considers the plain roller, chipt cross-wise, a great improvement. He adds, that damp straw is threshed with much inconvenience by fluted rollers. They are not only troublesome, but dangerous. Indeed, he had a man who lost his life by being entangled in the rollers, whilst attempting to cut the rolled or *lapped* straw from the roller. A chipped roller also, is well calculated, not only for threshing oats in a damp day, or the wet bottom of a stack, but also for threshing rank pease, a point of considerable importance. Mr Dudgeon of Prøra uses three hands to feed the machine, if the pease or beans pass through to any degree of thickness between the rollers, and they receive only that degree of threshing which is necessary for separating the corn from the straw.

It is well known, that accidents have often happened from the difficulty of informing the driver of the horses, that the machine should be stopt. Mr Erskine of Marr has obviated every difficulty of that sort, by hanging a bell, the string of which is within the reach of the feeder of the mill, and by teaching the horses to stop immediately when the bell rings. The horses are also taught to proceed

again, when the bell rings a second time. The same plan was carried into effect by Mr Dudgeon of Prora, in 1804. Mr Dudgeon observes, that it is not only proper to have a handle near the feeder, to warn the rest of the servants, and the horses, when any occurrence renders it necessary to stop them, but to have one in the opposite, or straw-end of the barn, to warn the feeder, when any accident happens out of his sight: he possesses the most powerful means of stopping the machinery, by casting in whole sheaves between the rollers, and circumstances have often occurred to require that precaution.

When horses are yoked in threshing-mills, they ought to have goggles, as they are so apt to look back. All horses should have breechings to enable them to stop the machine, and many have been killed, and much mischief done, owing to the want of so essential an article. The lever, by which the mill is wrought, ought always to be placed above the horse's back.

It is a most essential improvement to make the horses work equally. To obtain that object, a plan has lately been invented by Mr Walter Samuel, a smith near Edinburgh, the apparatus of which is simple and cheap, not exceeding 20 s. *per* horse, by means of which, it is contended, that not only the horses are comparatively greatly eased in the most severe labour in which these useful animals are employed, but that a great saving results in the wear and tear of the machine, from the regularity and uniformity of the movements.\*

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\* An eminent breeder of horses near Howden, in Yorkshire, who sold at one fair, ten horses for 1000 guineas, informed me, that he found the threshing-mill an excellent mode of breaking horses, accustoming them to noise and labour. Fine horses, however, could hardly be ventured in such a machine, without the improvements above detailed.

Mr Scott at Ormiston has constructed an improvement, by which that resistance, which is so great and oppressive to the horses, when wheat, or corn of strong growth is threshed, can be easily removed or lessened, by the foot of the person who feeds the machine, pressing upon a bar or treddle, which has the instant effect of raising the upper roller in such a degree, as to allow the bottom of the sheaf to escape with more ease, and thereby lessening the draught of the horses. This plan has been put in practice by Mr Park of Windymains, and may answer, when the person who feeds the machine is careful and attentive. The expence is only about fifteen shillings.\*

Mr George Mitchell, at Bishop Mill, near Elgin, in Moray, has discovered a mode for dressing barley in a superior manner, by means of cheap machinery annexed to the threshing-mill, an account of which will be given in the Appendix.

Some farmers think it an improvement, to yoke their horses in pairs, in the same manner as they do the plough; but this is attended with a loss of the power applied, the one horse being compelled to travel over more ground than the other.

Great diversity of opinion is entertained, regarding the kind of threshing-mill that is easiest wrought, some contending for two movements, some for three, and others for four. Mr Rennie of Phantassie recommends a mode of trial, which he thinks would set that matter to rest, that of having three or four models of different movements, but of equal power, to be constructed by an able mechanic, and these to be wrought by means of weights, which he

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\* For a plate and description of this improvement, see the Farmer's Magazine, No. XLVII.

thinks would at once ascertain which of them had the easiest draught; at the same time, it would be difficult to say, with any degree of correctness, which ought to be preferred. If, instead of models, real machines were to be made use of, it would be necessary, in order to make the comparison complete, that the machines should be all new, and that the same horses, the same sort of grain, if possible from the same field, and the same driver and feeder, should be employed to the machines driven by the different movements. The great object, however, is, *clean threshing*, without which, facility in movement is no advantage.

As to the cost of erecting a threshing-mill, the expence, on an average, may be calculated at L. 200 for each machine, including the horse-shed, the fanners, and the loft connected with the framing of the machinery, but exclusive of the barn, the barn lofting, &c. This expence, owing to the higher price of wood, is not likely to be diminished. Mr John Shirreff at the same time remarks, that that must in some degree be counterbalanced, by the present more general introduction and employment of cast-metal segments and pinions, in the construction of which much labour is saved, and consequently wages to the operative mill-wright.

4. Many unsuccessful attempts have been made, to construct a threshing-mill at a low price, so as to answer the purposes of small farmers, and that object has at last been accomplished. Mr William Johnston, an ingenious mechanic, at Langholme, in Dumfries-shire, has contrived a machine on Meikle's principles, which may be purchased for so low a sum as even L. 8, and may be driven by two men, though a small horse, water, or wind, would be a better power to apply. An account of this machine, and an engraving of it extracted from the Farmer's Magazine, will be found in the Appendix, No. XX. There is no doubt of

its being perfectly adequate to threshing the crops of small farmers; and it is more likely to be adopted in foreign countries than the larger machines.

Upon the whole, after the experienced advantage of powerful threshing-mills on large farms, they have now become, not only most useful, but almost indispensably necessary; and farmers who have been accustomed to the dispatch, security, and economy, which they contribute to the management of extensive concerns, would find themselves reduced to most unpleasant inconvenience, should any circumstances oblige them to have again recourse to the flail.

6. MISCELLANEOUS ARTICLES.—The other implements used in Scotland are not numerous, consisting principally of bean and turnip drills, (drill-machines for corn are not frequent), stone, wood, or cast-metal rollers,\* and scrapers, or shovel-ploughs, none of which are either expensive or complicated. A horse-rake for gathering corn stubbles after the scythe, has lately been introduced into some parts of Scotland, and has given satisfaction.

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\* One of my correspondents has tried a roller made of Aberdeenshire granite, with which he is much pleased. Every person, he observes, knows how imperfectly the large wooden roller acts in the pulverizing process, and in many districts it has generally given place to the smaller metal roller. But the granite roller is greatly superior; it is cheaper; it will last for years; and is so weighty, that it may be made of as small a diameter as is necessary. It is said by those who have tried rollers, that they should not be less than twelve inches in diameter, nor more than thirty, because, if too small, they are apt to push the hard clods before them, and if too large, to force the clods into the soil, or to rest upon them instead of breaking them. Some recommend hollow cast-iron rollers; but in that case, it would be advisable to have a machine for conveying them from one field to another, to prevent their breaking. It might be set on low wheels, and an inclined plane of stout plank used for drawing it by a horse, or two, if necessary.

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ON the whole, it may be safely asserted, that there is no country in Europe, where farming is at all understood, where the implements of husbandry are so few, so simple, so cheap,\* or so effective, as those in Scotland—a circumstance of infinite moment to the industrious husbandman.

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SECT. VIII.—*Of Live Stock.*

IT is a common remark, that the farmers of Scotland, in general, seldom think of bringing their sheep, their cattle, or their hogs, to that extraordinary degree of fatness, which is the pride of the English breeders and graziers; for which, indeed, the Scottish graziers have but little inducement, (except on the borders, where they are within reach of the Morpeth market), as, owing to the difference of taste between the two countries, the English mode of feeding stock would not pay in Scotland.† Without discussing the

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\* The threshing-mill, though it costs a considerable sum, yet is the cheapest of any, considering the work it performs.

† It is questionable whether this great fatness is useful to the public. Some families have given up butchers who pride themselves on selling very fat meat, finding that it made no way in feeding their family, so much of it being rejected. The great object is, to ascertain the net profitable weight, produced by the different breeds, at the smallest expence.

propriety of fattening animals to such a pitch, or the refinements of modern breeding, it may be sufficient to observe, that the breeds of live stock in Scotland are, on the whole, well calculated for the soil and climate of that country; and that many of them are distinguished by most valuable properties, which are not to be surpassed, and indeed are rarely equalled, by those of any other country.

The observations on this subject shall be confined to the four principal sorts of live stock; 1. Cattle; 2. Sheep; 3. Horses; and, 4. Hogs.

1. CATTLE.—In the General Report of Scotland, a particular account will be given of the various breeds of cattle in that part of the kingdom. It may be observed in general, on the authority of a most respectable correspondent, (Mr Trevelyan of Netherwitton, near Morpeth), that the farmers of Scotland, are too apt to overlook and undervalue their own breeds of cattle. In regard both to beauty of form, and quickness of feeding, they are equal to any, and would improve still more, were the same care taken of the calves as in the southern districts. Even as matters are conducted, for delicacy of eating, and excellence of form, nothing can surpass the small breeds in the northern parts of the island, the Kyloes, or the cattle of the Isle of Sky, and other islands in the Hebrides, and the west country Highlanders, or cattle of Argyll. It is maintained, indeed, by a gentleman, eminent for his skill in breeding, that a mixture of the Kyloe blood, in a small proportion, and done with judgment, in a proper manner, and at a proper time, would do good, even to the best short-horned stock. He adds, that there is not any other breed, but the Kyloe, that would admit even of a small mixture with the short-horned, without injury to the breed.

Of a larger description than the Kyloe, and from their

form admirably calculated for fattening, is the Galloway breed, and next the cattle of Fife, Angus, and Buchan, which are nearly the same, differing only in size.

In regard to the dairy, the cows bred in several districts of Ayrshire, Cuningham in particular, which have since spread into the counties of Renfrew and Lanark, and other places, are justly celebrated.

In discussing the subject of cattle, it is proposed to make some observations, 1. On the feeding of cattle, and the profit attending that practice, more especially when compared with sheep; 2. On dairy cows, and their management; and, 3. On the working of oxen; concluding with some additional particulars, which it is necessary to explain in regard to this branch of the enquiry.

*Feeding Cattle.*—As the farmers in the more improved districts of Scotland, are not partial to old turf, and rarely have any extent, either of permanent pasture or of meadow land, it is usual for them, instead of breeding stock, to purchase cattle or sheep from the breeding districts, and to fatten them for the market. This is a system which must be considered as highly beneficial to the country in general, and is peculiarly advantageous to the arable farmer, who is thus enabled, to keep a greater extent of his farm under the plough. The expence, and the risk of breeding great numbers of animals, are thus avoided. The attention of the farmer is not distracted by a diversity of objects. He can alter his system, from cattle to sheep, or from sheep to cattle, as is likely to be most profitable; and the capital he lays out is speedily returned. The division of professions between breeding and feeding, though they may be united in peculiar favourable circumstances, yet, on the whole, is a most important link in the progress of agricultural improvement.

Cattle may be fed, in pastures, in fold yards, in open

sheds or hammels, or in stalls. These points have been already discussed, (See Sect. II.); but some observations still remain to be made on stall-feeding in general.

By some, feeding cattle in stalls is objected to, as rendering the animals unhealthy. An experienced farmer, however, affirms, that in the space of twenty years, during which he fattened several hundred head of cattle, he has tried feeding cattle of the same sort, some loose in a warm shade, some in the open court-yards, and some in stalls, and that the last, so far as his experience goes, was the preferable system. It is proper to observe, that those fed in the stalls, were well curried, kept very clean, to which, probably, this farmer's success in stall-feeding was owing. Care also was taken, never to put more turnip, or food of any other sort, than they could eat up at once, and carefully to remove any small quantity unconsumed, otherwise they are apt to loath it. And here it may not be improper to observe, that though the general principles and practices of husbandry are already sufficiently understood, yet that much information is still wanting regarding the minutiae of this, as well as of other branches of agriculture, on a due attention to which, the success of the farmer must necessarily depend.

As an additional proof of the justness of that remark, I am led to state the particulars of an experiment made by a respectable farmer in East Lothian, (Mr Dudgeon of Prora), which proves how much depends upon supplying cattle, fed in winter, on dry food, with a sufficient quantity of water, and the necessity of sparing no expence in furnishing them with that essential article in abundance.

Mr Dudgeon having a number of Highland cattle consuming straw \* and chaff, on a farm unfit for turnips, an

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\* Mr Curwen is of opinion, that a moderate quantity of straw contri-

old man was appointed to ascertain, how often they went to a watering trough, within the close, in a short cold winter day. That he might not be confused in the execution of his orders, one particular bullock was pointed out, on which he was to make his report. According to that report, which there is every reason to believe may be relied on, he drank *eight times* in the course of the day, and the man was convinced, that all the rest of the cattle drank as often as the one fixed on. How then is it possible that they can be properly supplied when they are sent out to drink? Twice a-day is as often as cattle are driven out to water, and some of them do not get one drink. The strongest, or most forward, first supply themselves, always abuse the water, and, (especially in a pond), render it unfit for the rest, and even for themselves, during the rest of the day. Their shivering attendant, glad to get them done with their drinking, hurries them back to the close. Indeed cattle are not able, at one or two opportunities, to drink a sufficient quantity of water, in cold weather, to moisten and digest coarse food. Mr Dudgeon, aware of this circumstance, brought in water by a lead pipe to a cistern, about seventy yards distant from a dam-head. The cistern consists of common rough building. A stone or trough is placed within the farm-yard, communicating with the cistern by a pipe of two-inch bore, and the trough, being upon a level with the cistern, it stands always full, being regularly supplied as it is made use of. This is a most valuable acquisition. Mr Dudgeon is convinced, that a moderate-sized ox will, by an abundant supply of water, improve much more rapidly during the course of a winter,

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butes much to the health of cattle, both working and feeding, and keeps their bowels in a proper state, when feeding on turnips.

if he is supplied with water when he requires it, than when he is only occasionally driven to it.

The profit to be derived from feeding cattle, compared to sheep, has been a subject of dispute. Mr Kerr calculates, that an acre of good feeding land in Berwickshire, will support a sizeable ox, or five full-sized Leicester sheep.\* The ox, he states, will increase in the course of the season to the amount of 16 stone, 14 lb. to the stone, or 224 lb. in all, and the five Leicester sheep will produce, besides the wool, on an average about  $12\frac{1}{2}$  stone of mutton, or 168 lbs. In the county of Durham, however, Mr Bailey of Chillingham estimates, that an acre of such land as will feed an ox of 60 or 70 stone, will feed from seven to eight sheep *per* acre. Such an ox, feeding on turnips, will consume from 20 to 22 stone *per* day. By experiments recorded in the Northumberland Report, tups of  $12\frac{3}{4}$  live weight, eat  $2\frac{1}{2}$  stones of turnips *per* day, which is at the rate of eight to one, comparing cattle to sheep. Hence, if they eat grass in the same proportion, and if, as is the case in the Morpeth market, when beef sells at 8s. *per* stone, sinking the offal, mutton fetches 9s., the calculation of comparative profit from these data will be as follows :

1. Eight sheep, gaining $2\frac{1}{2}$ stones each, or 20 stone in all, at 9s. <i>per</i> stone, or L.1 : 2 : 6					
<i>per</i> sheep,	-	-	-	-	-
					L.9 0 0
2. An ox gaining 16 stone at 8s. <i>per</i> stone,					6 8 0
					<hr/>
Difference in favour of sheep,					L.2 12 0

\* See Kerr's Report of Berwickshire, p. 320. Mr Kerr makes the winter proportion on turnips, ten sheep to one moderate-sized fattening ox, with the addition of straw. Ditto, p. 279,

If seven sheep are taken, the balance would be L.1 : 9 : 6. If six sheep, the difference is 7s. in their favour; but at five sheep, the balance is 15s. 6d. in favour of the ox.

It is necessary, however, to take into consideration, the hide, on the one hand, and the skins and fleeces, on the other; also the value of the manure they respectively produce. The latter is evidently in favour of the sheep; for it can hardly be doubted, that two years' pasturage with sheep, will improve the land as much as three with cattle.

The experiments of Mr Hunter of Tynefield, however, are decidedly in favour of cattle, when stall-fed. From 30 to 32 tons of turnip, (the average produce of an English acre), will fatten ten sheep, from 12 to 14 lb. *per* quarter. The same quantity of turnips, he finds, will fatten at least two cattle of 30 stones Amsterdam each, 16 lbs. to the stone, and 17½ ounces to the pound. He therefore maintains, that more beef than mutton, to the amount of 440 lbs. Amsterdam, will, on an average, be produced, from equal weights of turnips, provided that the turnips be consumed *at the stall, by the cattle*. In this case, however, an expence is incurred by conveying the turnips to the stall. The dung, at the same time, is more disposable, and a quantity of straw, that might otherwise be of little value, is converted into rich manure.

This, however, is not the only point of view in which the subject is to be considered. A Berwickshire farmer informs me, that he usually purchases in October, at the Falkirk tryst or market, about eighty Highland bullocks; he winters them on straw and meadow hay, and feeds them off for the butcher the following season, in grass inclosures taken for that purpose. They are bought, on an average, at about L.9 *per* head, and will fetch, when fattened, from L.14 to L.15 each. Is any plan more likely to be profitable, more especially if the grass fields are not taken too

high? Or can any other sort of breeding or feeding stand a comparison with such a system?

Some graziers are of opinion, that a mixed stock of cattle and sheep always pay better, than when they are pastured separately. They improve the ground more, and are fattened with more economy.\* Mr George Culley states that to be the result of his experience as a grazier, for no less a period than sixty years. Mr Robertson of Ladykirk, who concurs in the same opinion, calculates, that an acre of ordinary grazing land in Berwickshire will feed well three shearling Leicester sheep, and that an acre and a half of such land, will feed a bullock of 60 stone weight. Two acres and a half, therefore, will, (when the stock is mixed, which it ought to be), produce the following sums:

3 sheep at 15s. each,	-	-	L.2 5 0
1 bullock of 60 stone,	"	"	3 10 0
			L.5 15 0

Consequently the produce of two and a half acres of English measure, of middling pasture, is only at the rate of L.2, 6s. *per* English acre. In rich land the profit must be still greater.

It has been justly observed, that there is not much stock that will pay the expence of grazing from the acquired

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\* It is objected to mixed pasturage, that cattle require a full bite, and sheep a close one. But the one should go after the other; first the cattle, and then the sheep. Besides the practice is, to allot the greater part of the pasture to either sort of stock, as may be thought most suitable. The grass produced by the droppings of the one kind is relished by the other.

weight solely. The profit of the grazier must arise, from the improvement of the whole carcase, in consequence of which, the value of the lean is increased, from perhaps 4 d. to 6 d. *per lb.*, or in that proportion, whilst the acquired weight sells at the higher rate. This is a point which should always be attended to in the sale, or the purchase, of lean stock.

*Dairy Cows.*—There is nothing of peculiar importance, in regard to the dairy management of Scotland, except in Ayrshire, and in the neighbourhood of Glasgow and Edinburgh. Though much attention has been paid to the breeding of cattle for the shambles, yet, in many parts of Scotland, the quantity of milk produced by the cows, (with the exceptions above mentioned), is very inconsiderable. Indeed, nothing else could be expected, from the miserable manner in which the cows were formerly maintained, more especially in the winter season, when they had nothing but straw to live on. This is the more to be regretted, because the dairy is perhaps the most pleasing of all the departments of husbandry, and as there is reason to believe, that converting herbage into milk, by means of a dairy stock, is the most profitable mode of employing it, and the most productive of human food. A great proportion of the herbage consumed is immediately converted into milk, which is drained off without loss, and as soon as it is prepared; whereas, when herbage is converted into flesh, a much greater proportion of it is constantly wasted, which must be constantly supplied. It is supposed, that the same quantity of herbage, that would add, as above calculated, 16 stone or 224 lb. to the weight of an ox, would produce 1800 Scotch pints, or 900 English gallons, of milk, which, even converted into cheese, (not the most advantageous mode of consuming milk), would produce 36 Ayrshire stones, at

24 lb. *per* stone, or 860 lb. of cheese, besides the flesh that might be obtained by feeding pigs with the whey. In point of profit also, there is no comparison, as the beef is only worth 8s. *per* stone, of 14 lb. each, whereas the cheese sells for 12s., and sometimes as high as 14s. or 15s. *per* stone, of 24 lb. each. More valuable produce, however, is necessary, as the dairy system is attended with more expence.\*

The profits of the dairy must necessarily be extremely various, according to the quality of the pasture, the age and size of the cows, the mode of feeding, &c.; yet, under proper management, they are very considerable. An eminent dairy farmer, Mr James Ralston in Galloway, states, that every cow on his farm, about two years ago, yielded annually her own weight in Dunlop cheese, then sold at 14s. or 15s. *per* stone, county weight; and, it is said, that he would not keep a milch cow, that did not yield cheese, in the course of the year, equal to her weight, and which would sell at the price of the cow. Under less careful treatment, an inferior return may be expected. When cows are furnished, and the food provided by one man, and when they are taken care of, and their produce sold by another, from L.12 to L.15 is paid for each cow *per annum*.

A farmer in the western parts of Scotland informs me, that he keeps some cows of the Ayrshire breed, and that they will yield, on an average, when the milk can be sold sweet, as taken from the cow, from L.18 to L.20 *per an-*

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\* It is said, that the 1800 pints of milk, is the produce of the whole year, and that the 224 lb. of beef, is the produce of the summer pasture only. Besides, the value of the lean weight is considerably increased, when an ox is fattened. It is the calculation in Berwickshire, that two cows, giving 1800 pints of milk each, will eat as much grass, as three oxen, of a moderate size.

*num* each cow; when the milk is churned, and sold in Glasgow, from L. 15 to L. 17; and when made into cheese, from L. 12 to L. 14, according to the quality of the cow, her condition, the manner in which she is fed, and her produce is managed. But in general, from L. 10 to L. 12 *per* cow, is reckoned a high average under the cheese system.

The Ayrshire cows, though generally of a moderate size, (from 30 to 50 stone live weight), yield a considerable quantity of milk. Some have produced from 18 to 20 Scotch pints, or from 9 to 10 English gallons *per* day, for two or three months after calving; these instances, however, are by no means common, and the milk of such cows, generally contains more serum, than those who give a less quantity.

The following estimate of the produce of Ayrshire cows, at an average, is by no means overrated :

	Scotch Pints.	English Gallons.
1. Produce for 90 days after calving, at 10 Scotch pints, or 5 English gallons, <i>per</i> day, - - - -	900	450
2. Produce for 90 days after, at 6 Scotch pints, or 3 English gallons, -	540	270
3. Produce for 120 days, at 3 Scotch pints, or 1½ English gallons, -	360	180
	<hr/>	<hr/>
Total estimated produce for the } whole year - - - }	1800	900

The Ayrshire cows are most probably derived from the short-horned breed, though much reduced in size from worse feeding. They certainly are a very suitable stock for the western districts; and it is surprising that they yield so

much produce, considering their miserable treatment in winter.

Mr Ralston's dairy farms in Galloway are certainly the largest concern of the sort in Scotland. He kept, some time ago, about 120 milch cows, and he is making arrangements for adding about 100 more to the number. The mode he pursues of feeding his dairy stock, is as follows :

They are never fed out of doors until the grass has risen to afford them a full bite : when the weather is dry and hot, they are housed, and fed on cut grass, from six in the morning till six at night, when they are turned out to pasture for the other twelve hours. During bad weather, they are housed both night and day, and fed plentifully with turnips, potatoes, &c. Chaff, oats, and potatoes are boiled for the cows after calving, and they are generally fed on rye-grass hay, during the latter part of the spring.

It is much to be regretted, that in many parts of Scotland, the farmers are not sufficiently attentive to the profits of the dairy. The late Mr Scott of Craiglockhart lamented that his dairy, owing to peculiar circumstances, was much circumscribed, being convinced, from experience and observation, that if properly attended to, it is the most profitable branch of agriculture. The drudgery is certainly great, and it is only a particular class that will give the attention necessary to ensure profit. Milking thoroughly, and feeding regularly, are first-rate objects. Green crops are now to be had in abundance at all seasons of the year ; and cattle thrive as well in a stall or fold-yard, as when roaming in the fields.

In the neighbourhood of Glasgow and Paisley, the farmers are particularly attentive to the profits of the dairy. The Ayrshire cows generally prevail, and they have in their possession some of the most perfect of that excellent breed. Such farmers as live within two miles of Glasgow or Pais-

ley, sell their milk in these towns, when newly taken from the cow. Those who are from two, and thence even to ten miles distance from town, generally churn their whole milk, and sell it, and the butter, in Glasgow or Paisley; and all who live at still greater distance, make the milk into cheese. The produce of these different modes will be in the proportions of 3d. *per* Scotch pint when made into cheese; 4d. when churned and sold in butter and buttermilk; and 6d. when sold as newly taken from the cow.

A very spirited attempt in the dairy line, has been lately undertaken by Mr Harley of Glasgow, who, after having visited all the principal dairies in the north of England, those of Mr Curwen, at Workington, in particular, resolved to establish a plan for supplying, on a great scale, the inhabitants of Glasgow, with milk of a quality they might rely on. He has erected houses, on a most ingenious construction, for feeding his cows; and the measures he has adopted, for keeping his dairy implements in good order, for conveying the milk to different parts of the city, and for preserving it from adulteration, will render his undertaking, not only highly useful to the city of Glasgow, but will furnish a model that ought to be followed in other places; as, by such means, large towns may be supplied with an article so essential for the health and comfort of the inhabitants, in its greatest purity.

The following is the substance of the information I have received, regarding the expence of maintaining milch cows in the neighbourhood of Edinburgh, and the profit attending it.

The cows were for some time grazed in the Marquis of Abercorn's park at Duddingston; they were afterwards pastured, and occasionally soiled, at Fillyside near Edinburgh. The expence of keeping them in summer and autumn, was at the rate of 1s. 3d. *per* day, or 8s. 9d. *per* week;

but in winter and spring, was necessarily higher. The milk was sold to retailers, but the net profit was inconsiderable, more especially when distillation from grain was prohibited.

The most important improvement that has recently taken place in regard to the management of the dairy, is the invention of cast-iron milk dishes, by Mr Baird of the Shotts ironworks, near Whitburn in West-Lothian. These dishes are made of cast-iron, softened by annealing in charcoal, turned smooth inside, then laid over with a coat of tin, to prevent the iron coming in contact with the milk, the rust from which might injure it. The outside of the dish is painted over, to prevent rust also. The advantages they possess over wooden milk dishes, are, 1. That they preserve that proper degree of coolness necessary to cause the milk throw up the cream, in which respect they are so preferable to wooden dishes, that the farmers' wives who have given them a fair trial, affirm, that they throw up one-third more cream, from an equal quantity of milk; and, 2. They are very easily kept clean, by washing them, and giving the inside a rub with beat chalk, on a little flax, or a piece of woollen cloth. It is well known the great labour that wooden dishes require to keep them clean; and should the dairy-maid allow milk to sour in them, it requires much time, and severe scrubbing, to make them sweet and fit for use again: but should milk be allowed to sour in the iron dishes, if they are washed clean, and rubbed all over with chalk, they become as fit for holding milk as ever. These milk dishes are softened by the annealing to such a degree, that although they should fall on a stone, they will not break, unless let fall from a great height. They will retain their coat of tin for many years; and should the tin wear off, from much usage, they can easily be re-tinned at small expence. They were invented by Mr Baird, and first made

at the Shotts ironworks, about the beginning of the year 1806. Several farmers in that neighbourhood soon tried them; and the demand for them is now so great, that the company can with difficulty make a sufficient quantity to supply the sales during the season.

*Table of Milk Dishes, as made at the Shotts Ironworks, near Whitburn, West Lothian.*

Numbers,	00	0	1	2	3	4	5	6	7	8	9	10	11
Contents in Scotch pints,	$\frac{1}{4}$	$\frac{1}{2}$	1	$1\frac{1}{4}$	2	$2\frac{1}{2}$	$3\frac{1}{2}$	5	6	7	$8\frac{1}{2}$	$10\frac{1}{2}$	12
Contents in English quarts,	$\frac{1}{2}$	1	2	$2\frac{1}{2}$	4	5	7	10	12	14	17	21	24
Price of each,	1s.	1s. 2d.	1s. 9d.	2s. 6d.	3s. 3d.	4s.	5s.	5s. 6d.	6s.	7s.	7s. 6d.	8s. 6d.	9s. 6d.

Mr Baird has also made a cheese shape, measuring  $17\frac{1}{2}$  inches diameter in the inside; the price nine shillings. The same article, (cast-iron), will probably be also extended to churns.

*On working Oxen.*—The propriety of working oxen has long been a subject of dispute. There can hardly be a doubt of the advantage of employing them in threshing-mills, a point which has been already sufficiently explained, (See Sect. 7.); but how far they are calculated for ploughs, and still more for carts, has not yet been decisively ascertained. The observations which have been transmitted to me by two most respectable practical farmers in Roxburghshire, (Mr Walker of Wooden, and Mr Walker of Mel-lendean), are so strongly in favour of the use of oxen, to a certain extent, in proportion to the working stock required

for a farm, that I cannot but submit them to the reader, as justly entitled to peculiar attention.

On the farms occupied by these gentlemen, there are kept fifty working horses,\* and twenty-eight working oxen. The oxen are broke in when three years and an half old. Two are used in a plough or cart, in leather collars and harness, in every respect the same as horses. They are laid off to be fed for the butcher, when six years and an half old, and consequently are only worked three years. During the summer months they are fed on grass; but from the end of harvest to the end of May, if the Swedish turnips hold out so long, their constant food is turnips and straw. They never taste any other food, except a small quantity of hay in the field while the ploughman eats his dinner. Upon this food, they keep in excellent condition, and are capable of doing a great deal of work; and when along with the horse-ploughs, they never lose a turn. In the winter months, when the days are short their whole work is taken at once; in spring, they come home in the middle of the day, and get as many turnips as they can eat. They are peculiarly calculated for breaking up coarse ground.

Mr Walker of Mellendean has three oxen to every plough, and by working only two at a time, and constantly changing them, every ox works only four days in the week. The saving, even on that system, is considerable. Each horse he calculates costs L.32:7:6, consequently a pair L.64, 15s.; each ox L.14; three oxen, therefore, cost L.42. There is thus a saving of L.22, 15s. *per* plough. Where the expence of keeping horses is higher, the profit by the use of oxen is proportionably more. Besides, while the horse (as Mr Walker of Wooden well observes), is yearly dimi-

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\* The horses are kept for road work, and distant carriage.

nishing in value, the ox improves till he is six or seven years old, and is then easily fed, and brought to market, at a greatly increased weight and value; and in case of death by accident or disease, to which, however, he is far less liable than the horse, even then the loss upon the ox is for the most part trifling; while, in the same circumstances, the loss upon the horse amounts to his whole value.

After the experience of upwards of twenty years, these gentlemen are of opinion, that oxen are fit for every agricultural purpose, travelling upon hard turnpike-roads excepted; that when employed in the plough, or indeed in almost any of the home labours of the farm, they perform nearly the same quantity of work as horses; and that where any extra stock is necessary for emergencies, when a great pressure of work may be required, oxen ought to be preferred; that they are peculiarly calculated for any farm where turnips are cultivated, and where there is no way of disposing of that crop, but by consuming it upon the farm itself. Where turnips cannot be raised, it is more doubtful whether they can be used with equal advantage; but the fact is ascertained, that one ox, fed with turnips and straw, will do more work, than two oxen fed with the best hay; and that with turnips, particularly the Swedes, there is no occasion to give any corn to oxen.

Several other intelligent correspondents concur in recommending the partial use of oxen.

Mr Dudgeon, Prora, had a pair of oxen which worked the plough, without a driver, and never lost one step when compared to a pair of horses. It was owing to the difficulty of getting others as well broke, and of procuring hands to work them, that they were given up.

Mr Wilson of Simprin, in Berwickshire, approves much of some oxen-ploughs being kept on large farms; as the oxen must improve greatly, when the weather is unfavour-

able for ploughing. On turnip farms they may be put to grass for fattening, as soon as the important season of turnips is over.

Mr Stewart of Hillside is of opinion, that bullocks will not only answer well for working a threshing-mill, but that they may be used to advantage in other work about a farm, provided that two or more pair of horses are kept for performing distant carriages. He breaks his bullocks at two years old, giving them only light work, and so moderately, as not to prevent their growth. It is easier at that early age to correct their faults, and to get the better of any bad habits into which some of them are apt to fall, than afterwards. At three years old, they will draw half a ton of potatoes, for two or three miles; at four years old, Mr Stewart has tried a pair of them, in competition with twenty horse-ploughs, greatly to the credit of the oxen. They are in all respects yoked and driven as horses, both in ploughs and carts.

Mr John Shirreff states, that in several parts of Aberdeenshire, he saw oxen-ploughs do as much work as horse ones, a pair in each; and he is convinced, that they will be found equal to horses in the plough, provided they be allowed a sufficient space of time, between their yokings or journeys, when they are worked twice a-day, to ruminate. This might easily be obtained, by going out very early in the morning, which would admit of a considerable interval between the yokings. If the same work could be done by oxen as by horses, why should not the same food be allowed them, if it is found really necessary?\*

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\* It is recommended by an intelligent correspondent, to give working oxen in mid-day some oat or barley meal. The ox would probably go to rest as soon as he had eat it.

Another intelligent correspondent expresses his conviction, that where twenty horses are required, it would be preferable to have sixteen horses and eight oxen. He always works his oxen with their collars reversed, that is, the broadest part upwards. In ploughing and rolling they are very useful. Horses are better in harrows, from their quick step, by which the pulverization of the soil is accelerated. In harvest likewise, when expedition is necessary, horses are to be preferred. In breaking up old turf land, however, oxen are better in the plough, their motion being more steady than that of horses; the flag is less broken in turning over, which is a great advantage. For short carriages, as in carting dung, turnips, &c. the advantage of using oxen must be very great; and they may occasionally be used in the plough, when the carts are sent for lime, or to the market with grain.\*

It is contended, that where oxen from 70 to 80 stone weight; (as is the case on the Borders), can be sold completely fat at three years old, that the farmer will find it more profitable to feed his oxen, than to work them; but were that even the case, it is evident, that if the price of horses, and the expence of maintaining them, should increase, the partial use of oxen may become necessary, and from the facts above detailed, it is at present, to a certain degree, advantageous. Besides, as the oxen grew older, their weight would increase, and the quality of the beef would improve.

2. SHEEP.—There are some of the finer breeds of sheep,

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\* The principal objection to the use of oxen, is the difficulty of shoeing them. Any improvement in the art of shoeing oxen, would be well entitled to a premium. Perhaps the shoes should go over, as well as under the hoof.

as the Leicester, the South Down, and even the Merino, to be met with in Scotland; but, in general, the sheep in that part of the kingdom are more distinguished for hardiness, than for fineness of fleece, or early maturity. They are improving, however, in both these respects, and the Cheviot breed in particular has nearly become, both for form and fleece, a perfect stock for a mountainous district. Where the flocks are numerous, (from 5000 to 10,000 often belonging to one farmer), it is impossible to pay minute attention to such multitudes, that they can possibly unite all the properties necessary for a perfect stock, namely, 1. Form; 2. Fleece; 3. Flesh; 4. Fat, and 5. Flavour: but I am persuaded, that the Cheviot breed, will soon possess the most essential of these important requisites.

Mr Robertson of Ladykirk states it as his opinion, that at a distance from manure, in a tolerable climate, and with sound land, nothing will pay the farmer better, than plenty of good grass, occupied by good Leicester sheep,\* and by good West Highland cattle, or by well-bred short-horned oxen and heifers.

It is recommended as a useful plan, instead of permitting sheep to range over an extensive pasture, or even a large inclosure, to confine them to a seven days' shift. This limited range of exercise, it is said, fits them sooner for the butcher; and when the sheep are at all of a wild or active disposition, it is calculated that one-third more stock may be kept by this expedient.

A correspondent observes, that the thriving of sheep, as well as of oxen, depends much upon the quality of the pastures. The herbage produced by some soils, will raise an

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\* Mr Robertson has brought his Leicesters to great perfection. I saw a three-shear ram which weighed 51lb. *per* quarter, and a two-shear, 50lb., fourteen pounds to the stone, and sixteen ounces to the pound.

ox or a sheep, greatly above the size and weight which they will attain on others, where the pasture is equally abundant. He sold a lot of lambs in July, to a person who had one farm in Northumberland, and another in Roxburghshire, between which he divided them. The Northumberland lot, which were kept upon bare pastures, upon rather a clay soil, were two pound *per* quarter heavier next year, than the other lot, and had also much more tallow. There is the same difference, in regard to quality of food, as between turnips raised on a soil with a mixture of clay in it, and a soil not having that advantage. This in some measure accounts for the superiority of the Swedes, being grown on stronger land.

Mr Church of Hitchill keeps a breeding stock of Leicester sheep, originally brought from Roxburghshire, which he seems to manage with great judgment, following the example of the great English and Border breeders in that line, which being well known, it is unnecessary to detail in this place. Mr Church considers the Leicester breed to be the best adapted of any, for inclosed arable farms, or for those in low situations, indifferently inclosed, as they are easily confined. He conceives it more advantageous to stock his farm with sheep than cattle, as they are perhaps more profitable in themselves, and certainly conduce more to the enriching of the ground by their manure, in particular from their resorting to the high grounds of any farm, which are commonly the thinnest and poorest soil. In a dry season also, upon even a bare pasture, they will thrive where black cattle would starve. An annual stock of sheep may often be considered preferable to a breeding one, in low warm situations, by rearing lambs for the butcher, and feeding their dams afterwards. But in any part of the country, remote from any good market for fat lamb, or for

buying in a proper ewe stock for that purpose, the breeding plan, he observes, is the most convenient.

Having already given to the public my sentiments on the subject of the breeding and management of sheep,\* it is unnecessary to resume that subject in this work. It may be proper, however, to observe, that where the carcass is the object, every prudent farmer will breed his sheep, free from that *extra* refinement, which tends to diminish the size which the animal would otherwise reach, prevents them from feeding to the greatest perfection, renders their constitution too tender, and in some measure destroys their fecundity. It is not intended, by this observation, to discourage the more general introduction of a breed of sheep, well calculated for arable districts, but there are bounds, beyond which, refinement will be found the parent of weakness and disease.

3. HORSES.—A gentleman who is carrying on agricultural improvements with great spirit, in the neighbourhood of Penrith, is of opinion, that the breed of horses in Scotland, is infinitely preferable, for the labours of husbandry, to any he has ever seen in England; combining action and strength in a greater degree than any of the English breeds; and he is convinced, that, on an average, they may be kept at much less expence. They certainly possess greater physical weight than blood horses, or those crossed by them, and consequently are fitter for drawing. Their make is strong, and as they go through their work steadily, they are less likely to waste their strength than others are apt to do. It is remarked, at the same time, that a little dash of blood

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\* See address to the Society for the Improvement of British Wool, inserted in a volume of miscellaneous essays, printed in one volume octavo, anno 1802.

is an advantage to a farm-horse; and a correspondent informs me, that he has wrought one, with a good deal of blood, for 15 years, and he still pays well for his food in doing extra work. In the same space of time, all his other horses have been changed three times. For the plough, and in particular for distant journies, a dash of blood is very valuable.

In considering this important branch of the enquiry, it may be proper to explain the following particulars, viz.—  
 1. The food given to farm-horses in Scotland; 2. The total expence *per* pair; 3. The advantages of working them abreast instead of lengthwise; 4. The quantity of work they are fit to execute; 5. The manner in which farmers in Scotland supply themselves with horses; and, 6. Any articles of a miscellaneous nature.

1. *Food*.—With a view of diminishing the expence of feeding horses, besides oats, hay, and straw, made use of so universally in other countries, the Scotch farmers have tried a variety of other productions, as, 1. Potatoes; 2. Yams; 3. Carrots; 4. Yellow turnips; 5. Swedes; 6. Boiled barley; and, 7. Whins; and not without success. They may at least be considered as useful, by diminishing the consumption of dearer articles, and promoting the health of that most useful animal.

Potatoes were tried for horses by Mr John Mackenzie of Glasgow, above forty years ago, sometimes raw, and sometimes boiled. The practice of steaming was not known in those days.\* Mr Stewart of Hillside, in Dumfries-shire,

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\* It is supposed to have been first introduced into Lancashire by Mr Wakefield, and Mr Eccleston of Scarsbrick-hall. In the first volume of the Communications to the Board of Agriculture, printed *anno* 1797,

has given potatoes to his horses for above thirty years. The quantity he gave was about 12 lb. at night, raw, and washed clean, having given them a feed of corn in the morning. He thinks it a great improvement to have them prepared by steam; and he is convinced, that when so given, the horses will do full work without corn, and will consume half less hay. His experience of the steaming process being recent, it is chiefly on the practice of one, whose account may be depended on, that this opinion is stated. The quantity of potatoes which serves a horse for twenty-four hours, is 42 lb. About the 10th of June, the horses are begun to be fed on cut clover, and continue to be so till Michaelmas; they get no corn during that time, unless a feed when sent for lime, coals, &c.; but it deserves attention, that the soil of Mr Stewart's farm is light, and friable, and easily worked.

Mr Robertson of Almon, with a peck of potatoes, or 28 lb. prepared by steam, mixes chaff; and Mr Cuthbertson, a most intelligent farmer in East Lothian, observes, that if a feed of potatoes is given once a-day to work horses, instead of one of the feeds of corn,\* which must otherwise be given them in the months of March, April, and May, it not only diminishes the expence of their maintenance, but is also extremely conducive to their health.

If potatoes at all answer the purpose, it is evident that *yams*, being much more productive, must be a still more profitable article to cultivate. It is well observed by a farm-

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there is an excellent account of their steam boilers, with a very accurate engraving of them, by Robert Beatson, Esq. They have since been brought to very great perfection, and carried on to a very great extent, by Mr Curwen of Workington-hall, in Cumberland.

\* Much depends upon the quality of the oats. Two feeds of oats of good quality, is equal to three of light corn.

er, who did credit to his profession, (Mr Thomas Scott of Craiglockhart), that of late years yams have been by many substituted for the evening feed. He adds, that if work horses can be subsisted with equal advantage on yams and Swedish turnips, what a promising prospect for increasing the growth of wheat, and bringing fields to a high state of cultivation, without losing a crop? One acre of yams or Swedish turnips, will afford more subsistence to cattle, and he maintained, to horses also, than two of oats, or any other sort of grain. By some, potatoes are preferred to the Swedes, being of a more laxative nature, and consequently better calculated for horses, when they are chiefly fed on dry meat.

Mr Gray of Gorgiemoor, on such soils as have too great a proportion of clay for growing potatoes to advantage, plants yams for his horses, and always keeps the land in open drills, from the time they are planted, till the crop is taken up, that is to say, without harrowing them down, as is done with the other drills; and, if it is not a very wet season, he has from thirty to forty bolls *per acre*.

In regard to the objection, that raw potatoes, or yams, are narcotic and deleterious, and give the gripes to horses, that is easily prevented, by giving them when the horses are cool, and at first in small quantities, increasing them gradually for some days. They will then do no harm. If horses get, at the beginning, a full feed of them, more especially if they have not before been accustomed to potatoes, they are very apt to be griped, and sometimes fatally.

Mr Paterson of Castle-Huntly states, that he is preparing to steam yams and potatoes, which is coming much into practice in the Carse of Gowrie. He has no doubt, that it will be a great saving in feeding beasts of every description, and, when deprived of their pernicious juices, abundantly wholesome. If given raw, to horses especially,

they are one great cause of the tinge or gripes, which often proves very fatal, if not early attended to; bleeding, emptying the bowels, and laudanum, as far as half an ounce, however, never fails to cure that complaint.

Mr Alexander Maclaurin of Edinburgh, strongly recommends steamed potatoes as food for horses, but the price has of late years been commonly too high. Mr Maclaurin received a letter, in June 1795, stating, that steamed potatoes, mixed with chopped straw, were then the constant food for horses at Liverpool, and answered well.

Carrots are not much cultivated in Scotland; but it is admitted, that they are an excellent food for horses. Mr Alexander Guthrie, who cultivates them near Edinburgh, states, that for working horses, he knows no food equal to the carrot, and of this he has had complete experience. Were the growth of carrots general over the country, and used as food for working horses, he is of opinion, that two-thirds of the oats consumed for that purpose, might be saved. In years of scarcity, this would be of great advantage to the nation, and a blessing to the poor.

The *yellow turnip*, has long been cultivated in the northern parts of Scotland, particularly in Aberdeenshire, and the neighbouring districts, where it is boiled with chaff, and inferior barley, and is given to horses at night.

It is well known, that the *Swedish turnip*, is a hearty food for horses, either given raw, or boiled, or steamed; and that horses are peculiarly fond of them. The following particulars, transmitted to me by Mr Hope of Fenton, in East Lothian, are not only decidedly in their favour, but worthy of particular notice.

For the three last years, Mr Hope has been in the practice of feeding his horses with Swedish turnips. In the spring months, when the horses begin to go two yokings a-day, he allows, to each pair, about one hundred weight,

or seven stones of 16 lb. each. He has found, from actual weighing, that his average crops are about 25 tons *per* Scotch acre; thus, one acre, at the above rate of feeding, serves five pair of horses fifty days. When his horses receive Swedish turnip in that proportion, they always get a feed of corn less *per* day, which, at 6d. *per* feed, or 1s. *per* pair of horses a-day, gives L.12, 10s. *per* acre, for the value of the Swedes, at the same time, fully one-third less of hay is sufficient. This saving, in the first instance, is not the only advantage; for he has uniformly found these valuable roots, are nearly equal to the finest grass in the month of June, for putting horses into the highest condition, and enabling them to perform the severe labour common during the spring. Indeed, by substituting the Swedes for a feed of oats, his horses have been, for the last two years, in a better condition, than he could ever make them before, although they had corn and hay in any quantity they chose to eat.

Some farmers also, give to their horses *boiled barley*. This practice is very strongly recommended by Mr Rennie of Kinblethmont, near Arbroath, who gives his horses one feed or lippie\* of oats, and one lippie of *boiled barley per day*. He was for a long time prevented from doing it, having formed an idea, that the high price of fuel, would counterbalance any advantage attending the plan; but by using a considerable quantity of the refuse of great coal, which burns perfectly well in a well-constructed furnace, he can safely assert, that the expence of coals, for boiling one feed of barley *per* day, for eight months, will not ex-

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\* A lippie is the fourth part of a Scotch peck, and weighs from 3 lb. 7 oz. to 4 lb. according to the quality of the oats; but the weight of the customary lippie, when heaped, as is the general practice, may be from 5 to 6 lb.

ceed 5s. for each horse; a sum never to be taken into consideration, compared to the difference in point of condition, in which he has always found his horses under that system, compared to that of former seasons, when they had a feed of oats in lieu of the feed of boiled barley. Although he is clearly of opinion, that one lippie of boiled barley *per day*, is of great use to cart or plough horses, still he would not recommend more, it being well known, that barley is very apt to scour horses too much; but the feed of oats, completely corrects too great a tendency of that sort. The barley that is used for boiling, is all the inferior sort produced on the farm.\* Mr Wilson of Simprin, who has had considerable experience in the feeding of horses, has always found oats, beans, and hay, *with a mash of boiled barley in the evening*, the best feeding, when he wanted work done. Swedish turnips, or steamed potatoes, he found, not only a cheap food, but sufficiently nutritive for young horses, and full-grown horses, when doing little work. It is singular, that though *boiled barley* is found to answer, *boiled oats* should not be so much approved of.

The use of furz or whins has also been tried, and found to answer, when properly bruised.

The soiling of horses, however, or giving them cut green

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\* Mr Maclaurin has also used many bolls of barley for horses, never altogether by itself, for hard-wrought horses, but mixed with oats and beans, when it answered well. He has very frequently also boiled it with beans, as mash for hard-wrought horses, mixed with bran, which is exceedingly salutary for them. He observes, that there is great nourishment contained in barley; it is very weighty, but it is thought too laxative for horses at quick hard work, to be used entirely by itself. A judicious mixture of it, however, among their oats, would improve that food exceedingly, and he has no doubt that horses would be able to stand their work better. But the price of barley, for these some years past, has precluded the general use of that grain in that way.

food, (the nature and expence of which will be afterwards more fully detailed), has been found the greatest improvement hitherto tried in the feeding of these animals; and, indeed, it is justly accounted one of the most important discoveries that has been made in agriculture. Bruising oats or beans, a practice to be afterwards explained, is likewise much to be recommended.

2. *Expence of keeping.*—This varies according to the size and value of the horse, and the work required of him. In Caithness, the average expence is computed at L.20 *per annum*; in the Mearns at L.24; a respectable farmer, near Arbroath, makes the expence L.27. Mr Blair of Montague, near Perth, keeps his horses on cut grass, from the 4th June, until about the middle of October; an occasional feed of oats is given when driving lime: for other two months, hay, and a feed of potatoes are given. During the short days in winter, good oat straw is substituted for hay; and as the days begin to lengthen in spring, hay is again allowed. Potatoes are then given, and one feed of oats; and when oat seed, and two yokings are begun, two feeds of oats are given with potatoes, as before. The above feeding, he estimates at 11s. *per week*; or L.28, 12s. *per annum*. In the county of Wigton, the expence of keeping horses has been estimated as low as L.15; but it is admitted, that a good farm-horse, properly kept, and fully wrought, will cost about L.25 yearly. Mr Stewart of Hillside, in Dumfries-shire, calculates the expence at L.17 : 15 : 2 *per horse*.\* It is proper, however, to remark, that in these

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\* It would require too much room, to enter into the details of all these estimates. In remote parts of the country, less work is exacted from horses, and consequently less food is given them.

calculations, the expence of the original purchase-money, and the value of the wear and tear, are not included, though these articles properly form a part of the annual charge, as much as the hay and corn given to the horses.

Mr Newton of Currie-hill, near Edinburgh, states the expence as follows :

Half an acre cut grass, first and second crop,	L. 6	0	0
Thirteen bolls and a half oats, at 22 s.,	-	14	17 0
120 stones of hay in the spring months, at 15 d.,	-	7	10 0
			<hr/>
	L. 28	7	0

He puts no value on the straw the horse consumes during the winter months, as he conceives the dung to be an equivalent.

Mr Cuthbertson, who gives a very particular detail of the expence of maintaining a horse, estimates it at L. 39 : 0 : 7½.

1. Soiling from the end of May to the 1st of November,	-	-	-	-	L. 12	0	0
2. Hay, 1½ stone <i>per</i> day, 30 days, 37½ stones, at 1s.,	-	-	-	-	-	1	17 6
3. Corn, a peck <i>per</i> day, for 30 days, 1 boll, 3 firlots, 2 pecks, at 30s.	-	-	-	-	-	2	16 3
4. Corn for December, January, and February, half a peck <i>per</i> day, 2 bolls, 3 firlots, 1 peck,	-	-	-	-	-	4	4 4½
5. Straw for ditto, at 10d. <i>per</i> day,	-	-	-	-	-	3	15 0
6. Corn for March, April, and May, 1 peck <i>per</i> day, 5 bolls, 3 firlots,	-	-	-	-	-	8	12 6
							<hr/>
Carry forward,	L. 33	5	7½				

	Brought forward,	L. 33	5	7½
7.	Hay for that period, 115 stone, at 1s. <i>per</i>			
	stone,	-	-	5 15 0
				<hr/>
		L. 39	0	7½

The corn usually given, and upon which this calculation is made, consists of oats and beans; when broken barley and beans are substituted, a trifling abatement may be made in the expence of feeding.

Mr Brown of Markle keeps twenty work horses on his farm, besides two supernumeraries, in case of accidents. He has transmitted to me, the following important calculation of the expence of a plough and pair of horses :

1.	Expence of each horse, when regularly fed, and constantly worked, according to the prices of the different articles in 1812,	L. 35	0	10
2.	Interest of money, and wear and tear of each,	-	-	7 10 0
				<hr/>
	For one horse,	-	-	L. 42 10 10
	Ditto,	-	-	42 10 10
				<hr/>
	Consequently for a pair of horses,	L. 85	1	8

3.	Horse tax, smith's account, and expence of keeping up the harness and implements which belong to a pair of horses,	-	12	0 0
4.	The ploughman, including all emoluments he receives, according to their value in 1812,	38	0	0
				<hr/>
	Total expence of a plough,	L. 135	1	8

The following are the particulars of the above expence of maintaining each horse:

17½ bolls of oats <i>per</i> horse, at 25s.,	-	L. 21 17 6
100 stone of hay <i>per</i> ditto, at 10d.,	-	4 3 4
Pease and bean straw,	- - - -	3 0 0
¾ acre of clover and tares,	- - - -	6 0 0
		<hr/>
		L. 35 0 10

The annual expence of a horse, depends much upon the circumstance, whether corn is given him through the summer months. In Mr Brown's case, each of his horses consumes about 4 bolls of oats, between the end of May and the commencement of harvest. The prices are stated at the rates of the year 1810.

In Roxburghshire, Mr Walker of Wooden, and his brother, Mr Walker of Mellendean, who keep in all no less a number than fifty working horses, calculate the annual expence of maintaining a horse, at L. 34 : 11 : 10½, according to the following estimate :

Three feeds of oats <i>per</i> day, for 34 weeks ; and two feeds <i>per</i> day for 18 weeks, is 16 bolls 2 pecks Teviotdale measure, or 21 bolls 6 firlots of Linlithgow measure, (6 Winchester bushels each), at 20s. <i>per</i> Linlithgow boll,	- - - - -	L. 21 1 10½
Three-fourths of an acre of clover and tares, at L. 5 <i>per</i> statute acre,	- - - -	3 15 0
One-fourth of an acre of Swedish turnips or potatoes, at L. 6 <i>per</i> acre,	- - - -	1 10 0
Hay at mid-day, in spring,	- - - -	1 10 0
		<hr/>
Carry forward,		L. 27 16 10½

	Brought forward,	L. 27	16	10½
Straw,	- - - - -	1	10	0
Shoeing,	- - - - -	1	0	0
Interest on price at L. 40, and casualties,		4	5	0
		<hr/>		
		L. 34	11	10½

This is independent of the expence of the implements, in the working of which the animal is employed.

In explanation of the above statement, it is proper to observe, that these charges proceed upon the average prices of the different articles, *in an inland part of the country*, where the value of many of them must be very considerably lower than in the neighbourhood of any large town, or sea-port. Straw, for instance, is charged only at 30s., which must appear extremely low, when compared with the cost of that article near Edinburgh, and yet it could not be fairly stated at more, 30s. being as much as can be got for wintering a three-year-old ox in Roxburghshire. A great difference will also be found, on comparing the charges for cut clover, tares, turnips, and potatoes; with the prices of the same articles elsewhere; but the prices above stated, are a fair average value of these articles in the neighbourhood of Kelso, excepting perhaps in regard to a few fields, immediately adjoining to that town. Even oats are worth at least 2s. *per* boll less there, than at a sea-port, or near a great market. These circumstances, will sufficiently account for a very material difference in this statement, from those received from other quarters, which must always depend upon situation, and a variety of other particulars. Indeed Mr Shirreff justly observes, that it is not so much the price, which is merely nominal, and always variable, which merits attention, as the quantity of grain, herbage, and roots, which the labouring animals

actually consume, and the amount of which, will preserve animals of the same weights and powers, in a condition fit for the labour required of them.

Such estimates throw much light on a most important subject; for, it is evident, that the rent of land, and the value of its produce, must, in a great measure, depend, on the expence at which that produce can be raised, of which the price, and the maintenance of horses, form a material part.

3. *Working lengthwise.*—Horses when working a plough in Scotland, are almost uniformly yoked a-breast. It is contended, that animal power is more advantageously exerted, when employed separately, and rather near to the work;\* and that it is hardly possible, when horses are yoked one before the other, or harnessed at length, that they will pull equally. The line of draught of the fore-horses, indeed, being horizontal, and not at right angles to their shoulders, their full strength cannot be exerted, and a considerable portion of the power employed, tends to act against, and to distress the horse next the plough or carriage; or, as Dr Coventry observes, a part of the power of the first horse is exerted, to press down the back of the one behind him, and a part of the strength of the latter to resist that pressure. More time also is lost, particularly in turning; in short, it may be reckoned, that with equal ease, two horses abreast, will do at least one-tenth more work, than the same horses will go through, when placed in a line.

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\* Mr Shirreff is not of opinion, that a horse draws either more, or more easily, by being placed *close* to his work; on the contrary, he maintains, that a plough goes steadier with long, than with short traces, and that the horses, being less confined, work easier.

4. *Quantity of Work done.*—This varies in different places, according to the soil, and the nature of the work to be executed. In the Carse of Gowrie, it is calculated by Mr Peter Jack of Moncur, that ten horses are absolutely necessary for 160 acres of that strong land, which is only at the rate of 32 Scotch, or about 40 English acres *per* plough; but these horses, as is usual indeed in other cases, have various sorts of work to perform, as threshing, driving lime, &c. The land in fallow, must be ploughed in general six times for wheat; for pease and beans twice; for oats, after peas, two or three times, and for barley three or four times; and they have to harrow about the same extent of land they plough. In wet weather, none can be ploughed; otherwise, instead of cleaning or preparing the ground, it would increase its strength and toughness.

Mr Brown of Markle informs me, that in East Lothian, the quantity of land usually ploughed by a pair of horses is, upon clay soils, about 40 acres Scotch measure, *per* annum, say eight acres summer-fallowed, eight acres under wheat, (succeeded by grass), eight acres oats, eight acres beans, and eight acres of wheat after the beans. This is given as an average, though, in particular cases, a greater quantity has been cultivated by a plough, than the number above-mentioned; yet, in many other cases, less is done: Hence 40 Scotch, or 50 English acres, is supposed a fair medium. On light soils, one-fourth more may be cultivated than upon clays, and with less trouble to the men and horses employed. A farm with a variety of soils, partly clay, and partly light, has this advantage, that it is practicable to cultivate the latter, when the former could not be attempted with the slightest prospect of success.

Mr Dudgeon, of Primrose-hill, in Berwickshire, states, that on an average, for six years past, the proportion of tillage, (that is, of land under corn and fallow), to each

plough, on his farm, is at the rate of 52 English acres *per annum*, and that he expects to increase that proportion, when his inclosures and other improvements are completed. Mr Walker of Wooden calculates, that one pair of horses, will work 50 English acres, besides their proportion of the other necessary business of the farm. Mr Nisbett of Mersington, on his farm at Stodridge, near Kelso, which is a soft light turnip soil, with six horses, or three ploughs, keeps in tillage 180 English acres, or 60 acres *per plough*.

The following is an abstract of the manner in which Mr Nisbett's farm of Stodridge is managed, and the stock, &c., required for its cultivation, which may be given as an excellent specimen of Scotch husbandry:

#### Rotation.

	Acres.
Turnips or fallow, - - - -	60
Barley, or spring wheat, - - - -	60
Hay, and clover for soiling, - - - -	60
Pasture, - - - - -	60
Oats, - - - - -	60
	<hr/>
Total,	300
	<hr/>
In tillage, therefore, - - - -	180
In grass, (for hay or soiling), and in pasture, 120	120
	<hr/>
Total,	300
	<hr/>

#### Stock, Ploughs, &c.

Number of horses, - - - -	6
Ploughs, - - - - -	3
Ploughmen, - - - - -	3

Steward, or bailiff,	-	-	-	1
Shepherd,	-	-	-	1

A labourer is sometimes employed for draining, and some aid is got in the harrowing season. Turnip hoeing, and harvest work, will, of course, require additional hands.

The rotation above described, is perhaps the best that can be followed, where the soil is suitable. It divides the labour throughout the year, in a regular manner, and under that plan, which is not unusual on the Borders, more work will be done, by the horses kept, than under any other system; for a pair of horses can plough 40 acres for grain, (20 after turnip, and 20 after grass), and 20 acres of turnips, with, perhaps, one supernumerary horse for every two ploughs, (which is generally found a necessary addition at some periods of the year), even though the farm should be at some distance from coal and lime.\* The only assistance received by the horses on the farm of Stodridge is, that a pair or two of young horses, are sometimes employed in harrowing the ground in spring; but, on the other hand, the horses on that farm, have sometimes assisted at Mr Nisbett's other farms, during harvest, Stodridge being an early place. Mr Nisbett's horses are of the best sort, and fed well.

In order to ascertain the nature, and the quantity of work capable of being done by a pair of horses, Mr Hope of Fenton, in East Lothian, drew up two diaries, one for a clay, the other for a light soil. The clay soil was supposed to contain 250 Scotch, or 318 English acres; the rotation as follows: 1. Fallow; 2. Wheat or barley; 3. Grass;

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\* In Norfolk, nine horses, and six men, besides a boy and a few women for hoeing, are considered to be necessary for a farm of 300 acres of arable land, managed according to the Norfolk system.

4. Oats ; 5. Beans ; and, 6. Wheat ; and, in that rotation, he calculated, that it would be possible for one pair of horses, to keep in cultivation, 42 Scotch, or 52 English acres. The following gives a general view of the nature of the labour they might perform :

	Days.
1. Ploughing, harrowing, and rolling, - - -	165
2. Threshing, - - - - -	47
3. Various works, as driving dung and fuel, market- ing grain, corn and hay harvest, road works, &c.	90
	<hr/> 302
4. Sundays, - - - - -	52
5. Days without work, owing to bad weather, holi- days, &c. - - - - -	11
	<hr/> Total, 365

Calculating the number of working days at 302, and the expence of a pair of horses, with the ploughman, &c. at L. 135 *per annum*, that is at the rate of nine shillings *per* day, and about one shilling *per* hour whilst working, summer and winter. How little is such an expence considered by servants, and often even by the masters themselves ? What losses are sustained, by errands to the smith's shop, frequent and unnecessary delays at the end of ridges, and other idle and pernicious practices.\*

In regard to a light soil, it would appear from Mr Hope's diary, that a pair of horses, on such a soil, may keep in cultivation, about 50 Scotch, or 62 English acres *per* plough. Much, at the same time, must depend, on the

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\* Farmer's Magazine, June, 1812, p. 231.

nature of the soil; for a dry sandy loam, requires more attention to keep it clean of root-weeds, than a dry gravelly soil.

In many parts of the country, however, the number of idle days, as stated by Mr Hope, are considered to be too few; and it is contended by a farmer, who has long paid attention to these matters, that instead of eleven days in a year, one day *per week*, besides Sundays, on the average of seasons, would be nearer the mark; as there are many days, and half days, equal, on the whole, to one in the week, during which the farmer derives but little benefit from his servants and horses. There must also be a difference of several days in the year, between the eastern and the western coast of the kingdom, owing to the greater humidity of the climate of the latter, and some acres less work will consequently be performed by a pair of horses.\*

5. *Mode of Supply.*—From the high price of horses, a number of farmers in Scotland endeavour to rear, on their own farms, a considerable proportion of the stock they require, though in many districts, they depend on the western counties of Scotland, and the northern counties of England, for a supply. In the Carse of Gowrie, it is usual to keep a spare horse on every farm, in case any accident should happen to the other horses, and to assist a mare or mares with foal, one or two of which are kept on each farm, by whose produce, the stock of horses is for the most part kept up. The farmer, therefore, has seldom any occasion to go to market for any other supply, excepting when he loses horses by accident, which too often happens. In other parts of Scotland, farmers keep breeding mares with the same view; and when attentive to their business, they find an advantage in

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\* Mr Curwen thinks, that from twenty-five to thirty English acres, are sufficient, on strong clay, for a pair of horses, on the coast of Cumberland.

it; but in that case it is necessary, that both the mare and the stallion, should be of the best cart-horse breeds, crossing with half-bred stallions, producing a very inferior stock. It is in general however maintained, that breeding and working horses, cannot well be combined, unless upon small farms, and that they do not give full labour throughout the year. Ploughmen, it is said, should always be employed with their horses, and not put to other work, while the mares are nursing. Besides, the foals come at the very time when their dams are most wanted, at least on turnip farms. Upon arable farms, it is considered to be the best plan, to buy 2½ year olds at Martinmas, to give them a little corn through winter, and harrow with them in spring. They may be occasionally worked through summer, (though it is better to let them run idle), and they will plough very well next winter, when rising four, provided they are well fed, for full feeding is every thing to a working horse. If horses are worked only five years, that is, bought when rising three, and sold at eight, they should bring at least prime-cost, if they have escaped accidents.

Some farmers object to the plan of breeding, because they lose the work of the mare wholly, for five or six weeks, but that is fully made up, by the work of the young horses, when two or three years old; and in this way, they not only supply themselves, but they are also enabled to sell their work horses, when at a high value, and sometimes an extra young one, which thus becomes a regular part of the return of a farmer.

Aware of this objection, (the loss of the work of the mare), Mr Allan has begun to try young horses with cows' milk, which he thinks a great advantage; indeed he has thus reared the best foal he ever had.\* It is a saving, as the mare can

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\* This practice is, I understand, known in Yorkshire. In many cases,

be worked a few days after she foals, and the milk of the cow, is not so valuable, (excepting perhaps near a large town), as her labour. One cow is sufficient for a foal. The foal and cow should go together; for the first fortnight, the foal should be fed four or five times a-day, afterwards three times a-day is sufficient; the milk to be given warm from the cow. If this system be carried on attentively for four or five months, there is no doubt, but the foal will be fully stronger than by suckling the mother. A great risk is also avoided, namely, that of purchasing a bad substitute for the mare. It might likewise be a good plan, on a farm where two brood mares are kept, to let one of them alternately suckle the foal herself, while the other was brought up by a cow. By that means, the mares would get a rest every two years, by suckling the foal themselves, and the work of one of them would always be saved.

Some farmers in Wigtonshire, accustomed to import horses from Ireland, are in the habit of frequently changing, (at least a part of them), by which means, they in some degree exempt themselves from the article of wear and tear, by a judicious mode of buying and selling. Where mares are chiefly purchased, and occasionally bred from, this may be done with some profit. The best farmers, however, avoid

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however, the cow's milk must be as valuable as the mare's labour. Mr Dods of Penston West-bank, has for years successfully used the milk of cows for fostering foals. But it is a dangerous expedient to put them together on the pasture. A cow with horns, might inadvertently injure the foal: Besides, when accustomed to the company of cows, it might be attended with much difficulty, if at all possible, to keep the foal from sucking other cows, if admitted to pasture with them. The most healthy method of rearing foals, is certainly in an open pasture, rather than soiling in any yard whatever, and a bad habit of sucking cows, might be the means of depriving the foal of that important privilege.

this practice, as incompatible with regular farming; for though breeding of horses to supply the farm, is in many cases a proper plan to adopt, since the prices of horses have become so high, yet frequent change of horses, or, in other words, *horse-dealing*, is not to be recommended.

It has been very justly observed, that farms, dedicated to the sole purpose of breeding horses, would certainly pay well at present, if the necessary attention were paid to the breed and management. Such farms are very much wanted, as an important link in Scottish husbandry; for the breeding of horses in the west of Scotland, will be always diminishing, as the farmers become better acquainted with improved arable management. There might probably be suitable situations found in the northern districts, for that purpose, especially if more winter food could be obtained, by the cultivation of floricin, or of Swedish turnip.

6. *Miscellaneous Articles*.—Some farmers adopt a mode, by which five horses will do nearly as much labour as six, according to the usual mode of employing them. One horse is employed in carting turnips during winter, or in other necessary farm-work at other seasons, without the necessity of reducing the number of ploughs. In carting dung from the straw-yard, three carts are used, one always filling in the yard, to meet the return of another empty; when the leading horse of the empty cart is unyoked, and put to the full one, by which means five horses may be said to do the work of six. In the same manner, while one pair of horses is drilling for turnips, the other three are employed in putting the dung upon the land, either with two or three carts, as the situation of the ground shall require.\* By extending

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\* It is necessary that the drills should be formed up immediately after the dung is spread, that the sap may be retained.

the same management to other farm operations, it is found, that a considerable saving of labour might be effected.

The grinding of oats or beans for horses, more especially when they get aged, and begin to lose their teeth, or have a custom of swallowing grain without chewing it, deserves to be recommended as a most excellent practice. The horses thus receive the whole nourishment; whereas, when given whole, many devour their corn entire, and it is seen to pass through them as they swallow it. Corn given bruised, it is said, will go about one-fourth farther than when given whole. Cutting hay, or straw, into chaff, may also be adopted with advantage, in the feeding of horses.

It is more the practice in Scotland than in England, for the farmers to give straw to their horses, though it is said that wheat straw is better fodder in England than in Scotland; the English cutting it knee high, and only giving the slender succulent part of the stalk to the cattle.\* A large proportion of the farm-horses in East-Lothian, and other districts, are maintained on peas and bean straw, during the winter months; but as that species of food loses its juices in the spring, hay must then be given. In regard to straw, the following observations have been transmitted to me by a correspondent residing near Edinburgh. He makes it a rule to sell all his straw, excepting what is ate by his own horses, and to buy dung. He gets for oat straw, from 10s. to 15s. a kemple, and for wheat from 8s. to 10s. *per* kemple, or from 5d. to 6d. *per* stone. A kemple weighs about 18 or 19 stone, although the regulations in Edinburgh market require that it should be only 16 stone. He never

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\* It is also said, that the farmers in England cut their wheat somewhat greener than those in Scotland, which preserves more of the natural juices, and of course makes the fodder better.

sells any barley straw, as he thinks it a better food for horses and cows than oat straw, although it does not bring so high a price by 3s. or 4s. a kemple : indeed, from experience he finds, that when he runs short of barley or wheat straw, his horses do not eat the oat straw for a night or two ; and he is convinced, that the preference given to oat straw, is not from its intrinsic value, but from the practice of our forefathers in doing so, and very properly at that time, as the oat crop was always the worst cleaned land, and full of couch and other natural grasses, which made the fodder better.\*

On the whole, the best and most economical mode of maintaining and of working horses, and the utility of employing oxen *partially* in the cultivation of land, are points of infinite consequence to the farmer and to the public. It cannot be questioned, that the more cheaply produce can be raised, at a lower price it can be furnished to the public, without injuring the interests of those by whose exertions it is raised. At present, we are under the necessity, for want of attention to the cultivation of our wastes, to import great quantities of oats from foreign countries, which has contributed to exhaust our specie, and to render the rate of exchange unfavourable ; but such an importation would be rendered perfectly unnecessary, if, either by an universal employment of two-horse ploughs, or single-horse carts, every third horse might be saved ; or if horses could have one feed *per* day of potatoes, yams, carrots, &c. instead of

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\* Mr Dudgeon of Prora informs me, that there are strong objections against giving barley straw to horses. They are commonly thought to be more subject to batts, (gripes), with barley, than any other kind of straw. Though the barley itself possesses certain laxative properties, the straw is thought to be astringent. The practice of my correspondent is certainly contrary to general opinion and experience.

oats; or on beans from fallows, being a meliorating crop, or if the partial use of oxen were adopted.

4. Hogs.—The breeding of hogs was formerly but little attended to in Scotland. In the counties bordering with England, however, and in all the more improved districts in Scotland, the prejudices which were formerly entertained against this species of stock, have in a great measure died away. One farmer in Roxburghshire states, that he keeps six or seven breeding swine; and in Dumfries-shire, and the western counties, a considerable number of hogs is kept, by which the quantity of Westmoreland hams, so celebrated in the London market, is said to be considerably augmented. On the whole, it may be accounted one of the defects in Scottish agriculture, that so profitable an animal as the hog, which thrives upon refuse which no other animal would consume, and the value of which is in a manner all clear gain, should not be more attended to.

I am informed by a farmer, that he keeps from five to seven breeding swine, and disposes of most of their produce, when from six weeks to three months old; considering this system fully as profitable as fattening them for sale. He generally has a good demand for them at these ages, as many people, such as tradesmen, villagers, &c. wish to fatten a pig or pigs, who could not conveniently keep a breeding sow. Having this advantage, there is scarcely a cottager or weaver's family in the neighbourhood, who have not their fat pig killed, after being fed on the refuse of their potatoes, and the offals of their kitchen, to the weight of from eight to twelve stone.

Another correspondent states, that on a small farm, of twenty-two Scotch acres, he has often fed from six to ten hogs, besides rearing a number of pigs, which he annually disposes of. In addition to the profit thence to be derived,

the quantity of excellent manure he raises, is the wonder of all the neighbourhood.

It may be proper to observe, that hogs may be fattened by potatoes alone, for immediate use, but if to be salted, that peas, or some substantial article of food, is necessary, to give more firmness to the flesh.

There is reason to believe, that the scarcity of pigs in Scotland, is partly owing to the want of information upon the subject. That obstacle, however, is now removed, a useful treatise on the breeding and management of swine, having lately issued from the Scotch press.\*

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SECT. IX.—*On the Soil and Subsoil, the Climate, the Elevation and Exposure, and the Situation of a Farm in regard to Markets.*

BESIDES all the particulars above enumerated, there are several objects of a miscellaneous nature, which will require the attention of the farmer, before he commences his arable operations, on any particular farm. These are, the soil and subsoil of the farm, its elevation and exposure, its climate, and its situation in regard to markets. It is evident that there must be such a diversity regarding these points, that it is hardly possible to lay down any general rules that can be applied to all cases; and yet the system to be adopted

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\* See *Treatise on the Breeding of Swine and Curing of Bacon, with Hints on Agricultural Subjects.* By Robert Henderson, Farmer, Broomhill, near Annan. Printed an. 1811.

by the farmer must, in a great measure, depend, on a due consideration of these circumstances combined. In point of fact, it is by his attention to these circumstances, that the good farmer is distinguished from the bad one.

Soils may be considered under the two great divisions of strong and light lands, though there are many intermediate shades between them. The crops to be cultivated in each, as well as the mode of management, must differ materially; for instance, it is a general rule, that wheat ought to be the basis of profitable husbandry in strong, and barley in light lands. In the latter species of soil, there is no difficulty in keeping the land free from weeds, by means of fallow crops; in the former, a summer fallow, once every six years, is considered by all the most intelligent farmers in Scotland, as essentially necessary to keep the land clean. Upon the nature and quality of the subsoil also, the system of management to be adopted must greatly depend.

The importance of climate to a farmer need not be dwelt upon. In many parts of Scotland, wheat cannot be raised to advantage, and in some cultivated districts it has never been attempted. In several districts it is also necessary to sow, instead of the two-rowed barley, the inferior sort called bear or big; and oats, from the hardy quality of that grain, is found to be the most profitable article. In others, peas or beans cannot be cultivated, from the periodical wetness of the autumn. In short, without great attention to the nature of the climate, no profitable system can be laid down by any occupier of land.\*

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\* On this subject Mr Stewart of Hillside observes, that we ought to do more justice to the industry of our forefathers, who grew corn in such situations, and high climates, as we see were cultivated by them. Our modern farmers would think it labour lost to attempt ploughing, where we see there were ridges and furrows some centuries ago, and crops

The farmer must also suit his system to the elevation, and even the exposure of his farm. The same plan will not answer at forty and at four hundred feet above the level of the sea; nay, much may even depend on the exposure of a farm, when situated in a hilly district. Where the soil, the climate, and the elevation is similar, the same crops cannot be cultivated, with equal advantage, on the northern, as on the southern side of the same hill.

The farmer must also take into his consideration, the articles most likely to suit the markets in his neighbourhood, or any others to which the produce of his farm can be sent; for instance, if there is no demand for fat cattle in the vicinity, he must employ his turnips in feeding young cattle, to be sent to other districts where they can be prepared for the butcher. On farms in the interior of Scotland, where wheat is not much in demand for bread, and where markets for that article are not accessible, either by good roads or water carriage, the culture of wheat is not to be recommended, and oats will be found, not only less exhausting to the land, but also more profitable.

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raised, without the aid of lime, which would now be considered impracticable. To account for this, and for the necessity of ascending so high with cultivation, is not easy. The lower grounds may have been too much wooded, which might occasion mildews, and these woods approaching the high grounds, would moderate the climate there. Certain it is, that for the two or three last years, the crops raised on the highest grounds of Dumfries-shire, have been more productive than on the holms of the dales.

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CONCLUSION OF THIS CHAPTER.

WHAT a field of reflexion presents itself, on considering the various topics discussed in the preceding Sections; and what advantages would redound to the public, from their being properly attended to, in every part of the united kingdom? The judicious position of the houses and offices of a farm,—their construction,—the proper arrangement of fields,—and inclosures judiciously planned, it appears, from the preceding observations, would add much more to the value of a farm, than on a transient view of the subject could be imagined. By a judicious system of draining; by good roads; by well-constructed instruments of husbandry; by the choice of proper live stock, and a due attention to their maintenance, the profit of the farmer must also be considerably augmented: and by combining, with a proper attention to all these particulars, a due regard to the soil, the climate, the elevation and exposure, and the situation of a farm in respect of markets, the farmer is enabled, to lay the foundation of a system, which will prove the source of his future prosperity.

Farmers have been too often ridiculed as a stupid and ignorant race; whilst, on the contrary, they are, in the more improved districts of Scotland at least, so well versed in the details of their profession, that there is scarcely a class in the community distinguished by a greater variety of knowledge. Instead of considering a *real farmer*, indeed, as an ignorant clown, he ought to be accounted, not only the most valuable, but also one of the best-informed indivi-

duals, regarding all those *useful arts*, on which must depend the prosperity and happiness of a great country.

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It is now proper to explain the means, by which the knowledge a farmer may acquire, can be made use of to the best advantage, in the cultivation of arable land; and the most advantageous mode of maintaining the stock kept upon the farm.

## CHAPTER II.

OF THE PARTICULARS CONNECTED WITH THE ACTUAL CULTIVATION OF AN ARABLE FARM, AND THE MOST ADVANTAGEOUS MEANS OF MAINTAINING ITS STOCK.

AFTER a system of management, regarding the various particulars discussed in the preceding Chapter, has been arranged, an attentive farmer, will next consider, what plan is the fittest to be adopted, for the actual cultivation of his farm, and the most advantageous means of maintaining his stock. The following points, with these objects in view, will require his peculiar attention:—1. Ridging his fields; 2. Manuring; 3. Ploughing; 4. Fallowing; 5. The Crops to be cultivated; 6. The Rotations to be adopted; 7. Sowing and covering the seed; 8. Weeding; 9. The harvesting of the grain; 10. The preparing it for market; 11. Soiling or feeding his stock with cut green food; 12. Whether it is proper to have any part of his farm in permanent pasture; and, 13. The best mode of making hay.

In discussing these particulars, the most important points, connected with the Scotch System of Husbandry, will be explained.

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SECT. I.—*Of Ridging.*

THE general advantages to be derived from ridges, are very ably stated by Lord Kames, in his *Gentleman Farmer*, (Chap. IV. Sect. 3). It is only necessary, therefore, in this place, to explain those more minute particulars, which have not hitherto been so much dwelt on, and which, without the assistance of a number of practical farmers, it would not have been in my power sufficiently to have elucidated.

On dry soils, ridges are of use merely as lines for marking out the operations of the plough, and the sowing and reaping of the crop; the nature of the soil, which is apt to suffer by want of moisture, rendering any sort of draining, which the furrows might afford, prejudicial rather than advantageous. Indeed, where grain is sown by drill-machines, ridges are not required for sowing the grain, as the drill itself, or a marker attached to it, regulates the operation: lines, however, may be of use in sowing the grass-seeds afterwards. But ridges are essential in wet soils, operating as open drains, without the assistance of which, the crops would rarely be productive in rainy seasons. It is of infinite importance, therefore, to the farmer, to be fully master of the rules, by which ridges can be formed to the best advantage. This subject may be considered under the following heads: 1. The proper length of ridges; 2. Their breadth; 3. Their straightness, and the best mode of altering the shape of crooked ridges; 4. Their height; and, 5. The advantage of ridging diagonally where the ground is steep.

1. *The proper Length of Ridges.*—The length of a ridge must vary, according to the size of the inclosures, the acclivity of the ground, and the nature of the soil, whether wet or dry.

On fields which have much acclivity, a long ridge is hurtful, not only as tending to fatigue the horses, and to overstrain them in their wind, but also because, after the ground is ploughed in winter, if much rain or snow falls, the surface of the ridge will be injured, more especially in the furrows, by the long-run, and large collection of water, by means of which the finer particles of the soil are washed away, and either carried off the field, or lodged on the head-land at the bottom. In such situations, ridges of about 150 yards are found to be most convenient.\*

In regard to wet soils, where the ground is flat, from 240 to 300 yards may be considered as the proper length: Were the ridges to be longer, the water might not easily get away; and if the field is longer, it is necessary, either to make a head-ridge across the hollow of the field, so as to form a level for carrying off the extra moisture, or, what is still better, without a head-ridge, to have transverse gripes or small open cuts, to conduct the accumulated water to the ditch, on one side or other of the field.

In dry soils, and where the land is level, the ridge may be still longer, and indeed some recommend from 700 to 800 yards; but, on the whole, from 350 to 400 yards seems to be preferable: When it much exceeds the latter size, the horses are apt to be fatigued, and with such a length, as little time is lost in ploughing and turning as could be well desired. Besides, when the ridge is very

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\* Remarks by Mr Stewart of Hillside, and Mr Charles Alexander of Easterhaprew.

long, it becomes more difficult to sow, and it has a tendency to discourage the reapers.\*

2. *The Breadth of Ridges.*—This is a subject on which there is a great diversity of opinion. As the question is of great importance, it may not be improper to state the reasons urged in favour of the different sizes, leaving the reader to judge, from the statements laid before him, which ought to be preferred, according to the peculiar circumstances of his soil and climate.

On wet land, a correspondent recommends ridges eight feet broad, to be ploughed crown and furrow. It is not necessary, he contends, in that breadth, to clean out the furrow; for there may be left, without any loss, a narrow slice, which would require another bout of the plough to finish. This is easily torn asunder by the harrow. There is a certain loss in cleaning out every furrow in the finished ridges, on wet land, unless one horse is yoked before the other, as the horses must unavoidably trample the land on each side the furrow, and the water lodges in their footsteps.†

In some parts of Roxburghshire, 14 feet ridges are preferred, both for expedition in reaping, and regularity of sowing; and a most respectable farmer in that country states, that when a young man, he was accustomed, for many years, to sow a great part of his own farm, and if

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\* Mr Dudgeon of Prora remarks, that upon a long ridge, the idea of ploughing wheat in, or under, upon wet soils, is strongly objected to, as the land must be greatly poached by the operation of ploughing, more especially where the ridges are small.

† I am informed, however, that it is not uncommon to take up the last furrow with one horse. The utility of clearing out the furrows, on wet soils, is self-evident. Indeed, what is the use of a furrow between ridges in *wet* soil, if it be not cleaned out so that the water may escape?

there happened to be any wind, (particularly a check-wind), neither he, nor any one employed with him, could ever sow a ridge of 18 feet, going once about, so as to give satisfaction; hence he was induced to adopt ridges of 14 feet, to prevent the seed from being unequally laid down. In Roxburghshire, however, they are more apt to be troubled by wind, than in the flat districts on the sea-coast.

Mr Wight of Ormiston, on wet soils, particularly thin wet clays, upon a retentive subsoil, has always found a ridge of 15 feet preferable to all other breadths. He is of opinion, that it is as easy to keep it dry as one of 10 feet, and easier than one of 18; that the furrows are not more bared than the 10 feet, and not so much as those of an 18 feet ridge. The 15 feet can be sown at all times with once going about, even when there happens to be a check-wind, which is not the case with an 18 feet ridge. The narrower one of 10 feet, will also require once going about, or up and down, which is a considerable loss of time; as the seedsman will sow equally well, in two-thirds of the time, a space of 30 feet, contained in two 15 feet ridges, than is necessary for sowing the same breadth contained in three 10 feet ridges. An 18 feet ridge sometimes requires three casts, which the 15 feet one never does. Two harrows, properly constructed, completely cover the 15 feet ridge, once about. If a field of 40 ridges, 15 feet broad each, require ten hours to sow and harrow it, the same field, of 60 ridges, at 10 feet broad, will require fifteen hours for the same operations. The 40 ridges will require 76 turnings of the sower and harrows, and 41 turnings of the water-fur plough. The 60 ridges will require 119 turnings of the sower and harrows, and 60 turnings of the water-fur plough. Besides, in all the other operations of the plough, one-third fewer *feerings*\*

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\* *Feering* is a provincial term, meaning that part of ploughing given in

are required for the one than the other. Three reapers are sufficient for the 15 feet ridge, the proportion of breadth not being wider than these can easily take. The 18 feet ridge is always oppressive to three reapers, and three reapers, on a 15 feet ridge, will seldom be behind four reapers on an 18 feet ridge, from each reaper, in the latter case, being obliged to stretch over 6, in place of 5 feet, to accomplish the proportion. On these grounds, Mr Wight is of opinion, that in wet soils and climates, the 15 feet ridges are preferable to all others.

Where land is of a loamy quality, but not wet, Mr Rennie of Oxwell Mains also prefers ridges 15 feet broad, as three reapers can easily work them, and they can be ploughed as described in the plan of 8 feet ridges. On land that is ploughed crown and furrow, the grain is equally good on every part of the ridge; but when rounded, and gathered up from the furrow, the grain is not only of inferior quality, not getting the sun equally, but, owing to the thinness of the crop, is with difficulty taken up.

Another intelligent farmer, gives the preference to 16 feet ridges, which, he contends, can be more correctly sown with two casts than the 18; besides, two gatherings from the level, lays them in a safe dry position; whereas, with 18 feet ridges, on flat strong clays, in a moist climate, two gatherings and a half are absolutely necessary.

Others prefer a ridge of 17 feet in breadth, as the best size for any soil. They urge, that in narrow ridges, upon wet land, much damage is done, when taking up the furrows, by the horse travelling so much upon the ploughed land, as they are compelled to do, when the ridges are made 10, 12, or even 14 feet broad, and much time is lost in so

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forming the ridges; in short, the first *two bouts* of the plough, whether the work is given along or across the field. The ploughmen are much valued, who are best at this operation.

many turnings and finishings: That if the land is wet, and requires to be laid dry in winter, two gatherings, if judiciously ploughed, will lay the ridge high enough for throwing off the water: That when sown, it can be accurately done with two casts, even in windy weather, and that three reapers, one man and two women, can work on it without interruption: Indeed, where only two men are employed by the piece, they universally agree in this particular, that they work with more freedom, and can perform, they affirm, more work, than if three men were upon a ridge, as each man cuts the precise half of it. In short, whether upon a wet or a dry soil, it is maintained, that a 17 feet ridge, is by far the best for ploughing, harrowing, sowing, and reaping.

Farmers, however, in general, on soils of a strong or clayey nature, prefer ridges of 18 feet. This breadth they consider to be the most advantageous for preventing wet, and for dunging, sowing, harrowing, and reaping. In regard to wet, there is a sufficient width to admit of a gentle slope on each side, effected by twice gathering the soil when ploughed, by means of which the surface-water soon gets down into the furrow. The dung also can be easily spread over the surface of such a ridge. As to sowing, it may be done by two casts of the seedsman, unless in high winds. A pair of well-made harrows cover the ridge at a bout,\* or once up and down the ridge, and three reapers

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\* A farmer in Roxburghshire states, that his harrows will not completely cover more than 12, or at the utmost 14 feet, at once a bout; and that when he harrows ridges of 14 feet, he is under the necessity of putting on five harrows, otherwise the work would not be done to his mind. The size of the harrows, at the same time, might certainly be enlarged; and harrows of the size common in the Lothians, will completely cover a 15 feet ridge, and do the work admirably.

are found a sufficient number to cut the grain, the centre one making ropes or bands for all the three, and none of them having far to go to lay in the corn they cut down: at the same time, where the crop is abundant, it is the most approved custom in East Lothian, to put four reapers upon such a ridge, and to cause two of them to lay the corn into one band, or, in other words, to have two rows of bands upon one ridge. In no other way will sheaves be made of a small size, and small sheaves are an important matter, especially in a wet harvest. It is a circumstance strongly in favour of an 18 inch ridge, that a farmer, near Dalkeith, who had been induced to try, on two different fields of 12 acres each, ridges of 10, and even 15 feet, was convinced, he said, *by dear-bought experience, of his error*, and had them all made up again into 18 feet ridges, twice gathered, and with his former good success. A neighbour of his, after several years trial, was obliged to adopt the same practice.

But though Mr Brown of Markle concurs with other eminent agriculturists, in preferring 18 feet ridges in wet or clayey soils, yet where the soil is deep enough to bear three gatherings from the flat, without sustaining injury, he is of opinion that a breadth of 24 feet may be adopted with advantage. Indeed, a great many of the ridges straightened by Mr Brown, are of that size.

On very dry porous turnip soils, it is of little importance, as has been already observed, whether ridges are formed at all, unless to regulate the sowing and cutting down in harvest.\* An intelligent farmer in Dumfries-shire, (Mr Church of Hitchill), when the soil is dry, has his ridges in general 30 feet wide; and Mr Rennie of Oxwell Mains, considers 30 feet to be the proper width in such soils, as it saves time in ploughing, having fewer furrows to clean out in the finishing the ridge; it also saves time in the

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\* Remark by Mr Hunter of Tynfield.

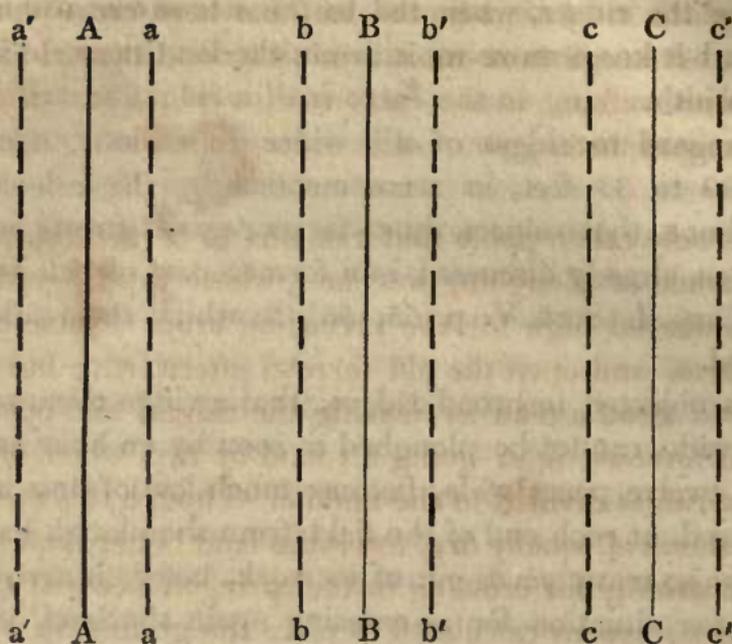
forming the ridges, when the land has been cross-ploughed; and it keeps more moisture in the land than ridges of a less width.

In regard to ridges of still wider dimensions, namely, from 30 to 33 feet, as recommended by the celebrated Arbuthnot, that subject, in so far as regards strong lands, has been already discussed in a former part of this work, (See Chap. I. Sect. V. p. 55, 56), to which the reader is referred.

It is objected to broad ridges, that a ridge twenty-four paces wide, cannot be ploughed so soon by an hour as two ridges twelve paces wide, because much loss of time is experienced, at each end of the field, from the plough having to move so many yards out of its work, before it arrives at its proper situation for re-entering again the land, whilst little or no loss of time is experienced, in the plough and horses swinging about to enter their work again, in a ridge twelve paces wide. But Mr Kerr obviates this objection by the following simple expedient: Supposing two broad lands, say of 60 feet, marked out by the furrows ABC. One ploughman begins along A, and ploughs the land, always turning round the points AA, keeping his right hand constantly to AA till he has ploughed 15 feet on each side of the furrow to a a a. The second ploughman has been doing the same round BB, and the third round CC. All now change their stations. The first takes the space between a a and b b, keeping his right hand alternately to BB and to AA. The second does the same between b b' and c c in the same way; and so of the rest. In this manner, there is no more travel in a 60 feet ridge than in one of smaller dimensions.\*

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\* It has been remarked, that this method is the one actually adopted in cross ploughing for fallows, and green crops; and it is well known to intelligent and experienced ploughmen.



It is evident, in addition to every other consideration, that the breadth of ridges must also depend upon the mode of culture. Where the broad-cast system is followed, the size must be calculated for enabling the sower to scatter the seed, in the manner the most likely to yield a productive crop.\* Whereas, when the drill system is adopted,

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\* It is said, that a good sower will scatter the seed sufficiently correct, in ridges of any breadth; but good sowers are not always to be met with. The breadth of ridges is therefore an important point to attend to, in regard to sowing, and also for the purpose of having the harrowing process, and the reaping, properly executed. A pair of harrows would cover 7 or  $7\frac{1}{2}$  feet; but as some allowance must be made for overlapping, 6 feet only can be depended on. Any multiple of 6, is therefore preferable to that of a different number. Each reaper will cut 6 feet, and it will generally be safer for the sower also, to go along the ridge once for every 6 feet, consequently thrice for 18 feet, &c. An hour or two is ill saved upon the important operations of sowing and harrowing, and

the breadth must be adjusted to the size of the machine. In wet or tenacious soils, it is an excellent plan, to have the horses walking in the furrows of a ridge, and drilling the whole at once.

The only other point that remains to be mentioned is, the method of ploughing wet land, where the ridges have been gathered high for the preceding crop. Some cross the ridges, and open the old furrows afterwards; but that is not so good a plan as cleaving the ridges, and opening the old furrows, after going a round or two, which leaves the old ridges divided in the middle. Though this method keeps the field equally dry, levels the land better, and gives an opportunity for crossing in the spring if necessary, yet it is by no means calculated to place the ground in a proper state during the winter season. But if the land is wet, it would not be advisable to risk cross ploughing, unless when the land is summer fallowed. I am informed, however, that few good farmers ever hazard the cleaving ridges of clay soil, except in the summer months.

3. *Straightness of Ridge.*—It is extremely material to have the ridge as straight as possible. Mr Curwen justly remarks, that it is the very essence of good ploughing to hold the plough even, which it never can be, if it has to work in a curve. It is calculated that ridges, when much crooked, measure considerably more in the serpentine direction, than when taken in a straight line, and consequently require more labour in ploughing, harrowing, &c.

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most sowers are not to be trusted, with sowing an 18 feet ridge equally with two casts, or going along one side, and returning on the other. The middle of the ridge, is often too thin sown by those, who have the vanity of sowing 18 feet with two casts.

than if they had been perfectly straight. That does not imply, however, that there is more land in the field. No form of ridges can alter the quantity within the same boundary; but their form tends to impede the operations of the plough as much as that addition to the land. In ploughing such ridges, every farmer who has had a plough in his hand, knows how awkwardly the plough moves in them. In the convex side it constantly inclines to take too narrow a furrow, and in the concave side the reverse, owing to the direction of the draft being different from the direction of these sides.

In regard to crooked ridges, many ridges, in the best cultivated parts of Scotland, were formerly very broad, much raised, and greatly curved. Levelling such ridges, in stiff wet clays, was a very difficult operation, and unless executed with considerable skill and judgment, productive of loss. It should never be attempted but in a year of fallow, and the straightened land should get a full dose of calcareous manure, and much cross ploughing, to mix the old and new staple, and to rouse the fertility of the soil brought at that time into action. An account of an improved mode of straightening and levelling ridges, by William Ward Jackson, Esq., near Stockton, will be given in the Appendix.

4. *Height.*—It is highly necessary that ridges, on wet land, should be well rounded, so as to form the segment of a circle. This is effected by gathering the soil once or twice, according to its dryness or wetness, in the course of ploughing the ridge. Indeed, Mr Rennie of Phantasie has often gathered the soil thrice, with much success, especially for a spring crop, as it not only lays the land dry through the winter, but enables the farmer to get sooner at it in the spring. The height, however, should

not be too great, only sufficient to furnish a declivity to let off the water; for when the crown is raised too high, one half of the ridge is always covered from the sun, (a disadvantage which is far from being slight in a cold climate), and the crop, which is always best on the crown, is more easily shaken by the wind, than where the whole crop is of an equal height.\* In arable culture, the more the equality of the soil, (which cannot happen where the ridges are high raised), the more equal will be the crop, and the more abundant will be the produce.†

5. *Line of Direction.*—The last point regarding ridges, which it is necessary to consider, is, the line of direction, more especially in steep grounds. In such situations, it has been found a great advantage, both for the facility of ploughing and for draining, to plough diagonally from left to right; the furrow going up the hill, falls off from the plough, the horse has better footing, and less pull, and the furrow catches the running springs.‡ This is particularly to be attended to in the case of drilled turnips; for owing to the many furrows between the drills, when the turnips are eaten off by sheep, not only the soil, but their dung and urine, are carried off, which greatly augments the evil. Besides, where the field is steep, the dung for the turnips can be much easier carted on diagonal ridges.§

In regard to steep banks or declivities, there are four modes in which the ridges may be laid out.

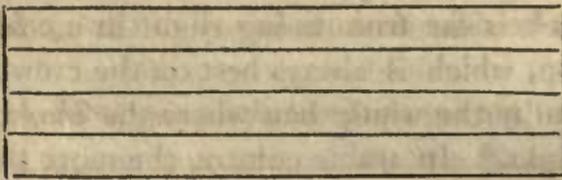
\* Gentleman Farmer, p. 74.

† Remark by Mr Charles Alexander, Easterhaprew. It is a great disadvantage, when ridges are too much rounded, that the sun cannot act equally upon the crop.

‡ Remarks by Mr Stewart of Hillside.

§ Remark by Mr Charles Alexander.

1. *When they are planted on the same line or level, thus:*



This is done partly with a view of preventing the soil and manure from being washed down, and partly from the idea, that it is easier for the cattle to work it. But it keeps up the water in the furrows, and is an awkward mode of ploughing. Sometimes this sort of ridge is carried all round a small hill in a spiral form, beginning at the bottom.

2. *When the ridges are straight up and down.*



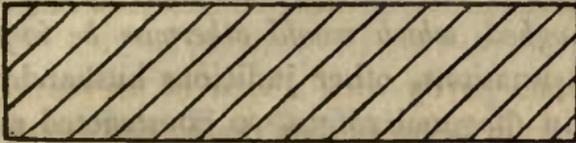
This is a very improper mode. The soil and manure are both apt to be washed down, and when the plough is going up, the earth makes such a resistance, that it is extremely difficult for the cattle to cleave the ground without the utmost exertions.

3. *From the top of the bank sloping to the left.*



This mode also does not answer, for when the plough is going up, the ploughman is obliged to force the earth against the bank, which makes but very indifferent work; and it cannot be done without injury to the cattle.

4. *From the top of the bank sloping to the right.*



This is the proper plan to be adopted, for when the ridges are laid in this manner, the ground always falls from the plough, as it goes upwards, without any great exertions on the part either of the ploughman or cattle. The ground is not forced against the bank, until the plough is coming down, and then it is done with so much more ease, that one-third less strength of cattle will plough an equal quantity of land.

Some farmers, however, when a field is very steep, plough only down hill, the plough being drawn up hill empty. By this method the horses travel up hill in less than half the time they could go with a furrow, and by being quite fresh at the top, they come down with spirit; and by giving the direction a little to the left in going down, the furrow falls away from the plough freely, every inch of the soil is perfectly raised, and lies so close together, that lying in that state for one year in some soils, and in others for two years, the sod rots, and being all laid one way, cuts easily by the plough; whereas, when attempting to plough against the hill, the ploughing is not half done, grows up in grass, and, when cross ploughed, makes a bad appearance. The fighting against the hill also, hurts a horse, in one day, more than three days' ploughing in the

way pointed out. Only one-fourth of the time is lost, but that is doubly repaid, by getting the work properly done, and the advantage in the after ploughing. Mr Blackie of Holydean, in Roxburghshire, who makes this remark, states, that he has cultivated a great deal of ground on this principle, and that he is never afraid of any land, however steep, if there is soil enough; *and that by this mode land may be ploughed, which would otherwise be impracticable.* In similar situations, other judicious husbandmen prefer ploughing in diagonal ridges, so constructed as to admit of ploughing up hill without material injury to the horses; and in this way the furrows are much less apt to be run away or sanded by heavy rains. Where the land is excessively steep, it is often necessary to plough directly across, throwing the plits or furrow slices all down hill; and, with the ordinary plough, going back empty. But where there is much land of this excessive steepness to cultivate, a plough with a shifting mould-board, usually called a *turn-wrest* plough, admits of ploughing both backwards and forward, shifting the mould-board in such a manner as always to throw the furrow-slice down hill. These two last methods have been suggested by Mr Kerr of Ayton, in his Berwickshire Report, who has seen both practised, and executed the latter himself.\*

Another rule regarding this point is, to direct the ridges north and south, if the ground will permit. In this direction, the east and west sides of a ridge divide the sun

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\* The Turn-wrest Plough, with a shifting mould-board, is certainly adapted to ploughing across the slope of hills, as it enables the farmer to turn the furrow always downwards. It is, however, attended with this disadvantage, that it brings, lower and lower, the staple of the soil.

equally between them, and will ripen at the same time.\* In clay soils, however, ridges must be regulated by the run of the water, so that no rule can be applicable to that particular case.

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## SECT. II.—On Manures.

IT is not proposed, in this general view of Scotch husbandry, to enter much at length, into the great subject of manures, on which so many volumes have been written. It may be sufficient to point out the sorts of manure commonly used in Scotland, and the mode of applying them generally recommended; together with any useful practices or improvements in the management of manure, peculiar to that part of the kingdom.

The manures principally made use of are, 1. Dung; 2. Urine; 3. Lime; 4. Marle; 5. Sea-ware; and, 6. Composts.

1. *Dung*.—This great source of fertility is hardly any where so much attended to as it ought to be, though of late years, more care has been paid in Scotland, both to increase the quantity, and to employ it to more advantage.

In considering this important branch of the subject, it is proposed to explain the following particulars: 1. The quantity raised from the different crops usually cultivated in Scotland; 2. The mode of making dunghills; 3. Whe-

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\* Gentleman Farmer, p. 79.

ther dung should be employed fresh or rotten; 4. The mode and time of application; 5. The depth at which it ought to be put; and, 6. Its price in the neighbourhood of the metropolis.

1. Dr Coventry has given the following estimate of the quantity of dung that may be procured from different crops, on land that will produce seven Scotch bolls, or twenty-eight Winchester bushels of wheat, *per* English acre.

	Tons.
By turnips, cabbages, and fallow crops, when applied to the feeding of cattle, - - - -	6
By clover, grass, or herbage, hay, &c. first year, -	6
By ditto, if mowed, second do. -	5½
By ditto, if pastured, second do.	5
By pulse crops, as beans, &c. part of their seed being used on the possession by live stock, - -	5½
By pulse crops, when the seed is sold, - -	5
By white or corn crops, as wheat, barley, &c. on an average of the whole, - - - -	4

It is no wonder, therefore, that green crops should be recommended as sources of fertility, producing proportionally much more manure, besides the other advantages with which they are attended; at the same time, the dung procured from the herbage, pulse, and hoed crops, is stated in the above table rather under the mark, and that from the straw of the corn crops fully high, in proportion to the other; the object being, to shew the comparative advantages of the different kind of crops, in respect of the manure they respectively afford.

2. Mr Rennie of Kinblethmont proposes, that dung, when taken from the dung-court, should be carried to the field intended to be dunged, and then laid into dunghills,

in order to promote fermentation ; that a person should attend for the purpose of throwing up the dung ; and that no cart be suffered to go upon the dunghill. Great care, however, should be taken, when the rank dung is thrown up, that it be sufficiently wet. With a view also of preventing the escape of the volatile alkali, it becomes very necessary, to cover up the dunghill with a light covering of finely-powdered earth, which tends greatly to increase the quantity of those oily and saline substances, which, in fact, constitute the value of every dunghill. If the dung is intended for wheat, he only gives the dunghill one turn ; if intended for turnips, two turns are necessary.\*

It perhaps may be here proper to mention, of what importance it is, to have the dung spread and ploughed in immediately, so that none of the most valuable parts may be suffered to evaporate ; and it is the constant practice, of all the best farmers in Scotland, to dung, spread, and plough in the manure at the same time, so that none of the dung is ever left exposed to the air. It is one of the great disadvantages of small farms, that these operations cannot be carried on in a systematic manner.

On the subject of dunghills, the following very useful suggestions are transmitted to me by Mr Dudgeon of Primrosehill, in Berwickshire, regarding the means of facilitating the fermentation of dung, when carried out in heaps to the field. The first is, never to allow the carts to drive on to the dunghill or heap when unloading, as the

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\* This covering with finely-powdered earth, as Mr John Shirreff remarks, is highly necessary, for if dung be turned twice after being deposited, and shaken up loosely, it will be of very little value, unless it be instantly covered at every turning. At all events, moving putrescent matter intended for manure, must necessarily be attended with the loss of some of its finer and most valuable parts.

condensation occasioned by the pressure of the carts and horses, tends to retard the fermentation, by excluding the external air. The second is, not to build the dung in lects, or upright sections, one by the side of another, as these never thoroughly coalesce, and allow the rain and moisture to drain off through the intermediate fissures; but in building the dunghill, let the surface built on, be always kept in a sloping direction from the top of the dunghill to the ground, which makes the dung settle into one uniform mass, thereby enabling it to retain the moisture; and for this purpose a slight covering of earth, (peat-earth, where it can be got), along the top, when the dunghill is finished, will greatly contribute: And the third is, if dunghills are formed in the field during winter, it has been found a good practice, when opportunity offers, to heap up snow on the top of them; for snow-water, being divested of its fixed air in the process of freezing, is thereby rendered a more powerful agent in promoting putrefaction, than either rain or river water, and from the snow melting gradually, the absorption is more complete, than when *water* is artificially applied.\*

3. It is not yet decisively ascertained, which is the best mode of using stable dung, whether in a fresh or rotten state. Mr Andrew of Tillilumb, near Perth, states, that he has sometimes seen it used successfully fresh, as, for instance, put on for potatoes, or ploughed down in the end of the year for beans; but he would rather incline to have

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\* Mr John Shirreff is of opinion, that stable-yard manure, ought never to be stirred, after it is deposited in the dung pit, till finally carted on the field, and deposited in the soil. For every time it is stirred, its finest parts escape into the atmosphere. In the way some people manage dunghills, more than one half of their most valuable parts are lost in steam, when shaken up as a gardener's hot-bed.

it a little rotten: care, however, should be taken, that in rotting, it do not heat too much; for if it turns dry and white, it certainly hurts it much. On the other hand, Mr Walker of Mellendean condemns the practice of using fresh dung, in so far as regards at least the turnip crop. For upwards of thirty years, he has found, in every year, that a small quantity of rotten dung is sufficient for that crop, and if the soil and season are suitable, will almost always ensure a good crop of turnips, and the succeeding crops, according to the common rotation. But he never yet could raise a full crop, with long fresh dung, however thick laid on; on this account, he is always at a considerable expence, about the end of April or beginning of May, in leading out, turning, and watering the dunghills, so that the dung may be in a putrid state when laid on the land in June; and after all, he is obliged every year to manure a part of his turnip land with fresh dung, and wherever it is laid on, the crop is invariably very much inferior, as are the succeeding crops in the rotation. The same remark is made, when land is summer-fallowed with dung. It is contended, indeed, that until the mass is heated, it cannot properly be called dung, and that though fresh or long dung, will go farther, so will straw, but that is no proof of its being more valuable.

Mr Brodie of Garvald, who has had so much experience in raising turnips, is decidedly of opinion, that the dung of cattle and horses should be properly blended, and well digested, before it is applied to turnips; and, indeed, he maintains, that turnips in drills would be better without dung altogether, than to have it applied in a long, half-rotten state, as it tends to admit the drought, instead of affording moisture and nourishment to the plants, while they are young and tender. Whereas, if the dung is of a good quality, a very small quantity generally insures a good

crop, especially if the grounds have been previously limed, and are otherwise in a good state of preparation.

Mr John Shirreff observes, that stable-yard dung can be most advantageously applied, when it is in a saponeous state, heavy, moist, and compact, when it can be cut with a spade, and when it emits a strong steam, and pungent odour. This state is very different from that to which dung is reduced by repeated turnings, which invariably leaves it open, light, and spongy, (much resembling muirish earth, or peaty soil), when its value must be considerably diminished.

The fact seems to be, that rotten dung is preferable, where drilling turnips is practised, and where a small quantity of manure is inserted in the heart of the drill.\* In regard to broad-cast crops of grain or turnips, however, fresh dung, (or the dung of stables, &c. applied as soon as made), will go, it is contended, over a greater quantity of ground; nothing is lost in the preparation, and it may be sooner made use of.

4. In Scotland, dung is principally applied, 1. To green crops, as turnips, potatoes, and beans; and, 2. To fallows.†

When applied to turnips, it is put in the heart of the drill, by which not one particle of it is either lost, or seen

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\* This objection to long dung, it is said, may, even in this case, be obviated, by making the hollows deeper. Long dung certainly answers well with potatoes.

† In England, top-dressings are sometimes applied to growing crops. Mr Adam Murfay informs me, that he has seen a mode of dressing barley-land, which has been attended with great success. Mr Joseph Hopkins, of Cholrey, near Reading, in Berkshire, has two pigeon-houses on his farm, which he regularly litters with malt dust, through the season; at the time he begins to sow his barley, he cleans out the pigeon-houses, carefully runs all the dung, when dry, through a sieve, until it is perfectly

above ground.\* Dung is generally applied to potatoes in the same way; but is sometimes laid on in autumn, and mixed with the soil. When in drills, it is recommended by Mr Laing of Campend, near Dalkeith; to make the drills across the field, if the ground is so dry as to admit of it, as by ploughing for the succeeding crop, the way the ridges lie across the drills, the dung is mixed with the soil; on the other hand, when the dung is put in drills as the ridges lie, (particularly in poor soils), in ploughing for the next crop, the dung is turned over in a body, and the crop grows very unequal; for where the dung is, it is very strong, and the other part, which is probably two-thirds, is very indifferent. It answers much the same purpose, if the lines are diagonally drawn. Dung, when given to beans, is generally applied on the stubble of the preceding crop, and sometimes in the spring, immediately before the seed furrow is given them. As to the time of carrying out and laying on dung, it saves expence if it can be carried out after harvest, but is most advantageously applied when the crops are sown. If applied to naked fallows, it

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fine for sowing, and just as the barley is pointing through the ground, he leads out the dung, prepared as above, and sows it on the land, at the rate of from eight to ten bushels *per* acre. By this plan, after a turnip fallow, or when turnips are eaten off by sheep, and prepared for barley, Mr Hopkins has had returns of from seven to nine quarters of barley *per* acre. A similar system might be tried with regard to other articles.

\* In a dry season, some recommend that the dunghill ought to be well saturated with water at the time it is put into the drill, and the earth immediately after turned upon it, in order to secure the turnip crop. Others contend, that dung, if attentively made, will always be moist, and that the process of fermentation and putrefaction will go on. Cold water would check these, and would prove adverse to vegetation, particularly of turnips, which ought to be promoted with all possible rapidity.

may be laid on in the month of July, and it should be ploughed in immediately after.

5. On strong soils, dung is generally mixed with the fallow, by one or two ploughings; and it is recommended, that the furrow, after it is laid on, should not exceed six inches in depth. Other farmers, however, contend, that as calcareous matter has a tendency to sink in the ground, and dung to rise to the surface, the former should be kept near the surface, *and the latter well covered in the soil.*\* When dung is lodged near the surface, it promotes too rapid a vegetation in the foliage, which rarely fails to diminish the produce of grain; a circumstance that necessarily circumscribes surface-dressing very much. If the ingredient is volatile, great part of it evaporates, and is lost. Top-dressings, therefore, except with composts, or lime alone, and on grass land, is not practised in Scotland, though not unusual in some parts of England, for young wheat, to give a fillip to the plant.

The propriety of employing dung as a top-dressing to meadow-land, is much disputed. It is usual in some parts of the kingdom, to lay on from fifteen to twenty double-cart loads *per* English acre, every three or four years; taking one crop of hay, and pasturing the land afterwards. The same quantity of manure would suffice for an arable system, on a succession of four crops; namely, 1. Turnips fed with sheep; 2. Spring-sown wheat or barley; 3. Clover; and, 4. Oats. In favour of the grazing system, it is contended, that old grass lands let for more rent *per* acre, than the adjoining fields under the plough, which is one reason why the proprietors endeavour to keep them in that

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\* Communication from Captain John Henderson of Aimster, in Caithness.

state : That such lands, if of the best quality, when in hay, will produce from one and a half to two tons *per acre*, and foggage worth 30s. *per acre* more ; or, when in pasture, each acre will graze an ox, producing, in the space of twenty weeks, fifteen stone of beef, worth 8s. *per stone*, or L. 6, to which, if the value of the after-eating is added, the whole will not be much less than L. 7, 10s. of produce *per English acre*, from which there are no other expences to be deducted, than rent and taxes, and the interest of the capital invested, nor is there that risk of losses, by wind, mildew, &c. as in arable crops : That farmers who are in possession of those old rich grazing pastures, find it their interest to keep them so, as essential for a breeding and grazing stock : That if all such lands were under a four-course system, in a few years the clover crops would become small and uncertain, and the quantity of live stock would be considerably reduced ; and that in many parts of the north of England, these old grass lands continue in verdure throughout the whole season, if the weather is open; and upon them, in a great measure, depends the maintenance of many thousand head of Scotch cattle. On the other hand, it is contended, that if the farmers were not compelled to lay their home-made dung on the old grass lands, which are thereby much enriched, whilst the adjoining arable land is excessively impoverished, and robbed of the dung it has been the means of producing, the latter would afford the highest rent : That if the farmers were not constrained to adhere to the grazing plan, they would soon discover, that it was more for their interest to pursue the arable system : That under the convertible system of husbandry, properly managed, (if necessary, pasturing the clover the second year), the crops of clover are not small and uncertain ; and that the arable system would certainly produce the greatest quantity of human food.

6. The following is the most accurate information that I have been able to procure, regarding the price of dung at Edinburgh.

Nature of the Dung.	Size of the Cart.	Weight of Dung.	Price.
Horse dung	Single-horse cart	From 14 to 16 cwt.	From 3s. 6d. to 4s.
Do. do.	Double do. do.	From 24 to 25 cwt.	From 6s. to 7s.
Cow dung	Single-horse cart	From 14 to 16 cwt.	From 3s. 6d. to 4s.
Do. do.	Double do. do.	From 20 to 24 cwt.	From 5s. to 6s. 6d.
Street dung	Single-horse cart	From 16 to 20 cwt.	2s. 6d.
Do. do.	Double do. do.	From 25 to 30 cwt.	From 3s. 3d. to 4s.

The usual mode of selling street dung, is by the solid or cubic yard, at 3 s. 6 d. *per* yard, which is an ordinary cart-load. If at any time a cart-load or two is sold without measuring, (which is considered a favour), four shillings are charged.

There is a good deal of tanners' exhausted bark used by farmers for compound dunghills, the price of which is generally sixpence *per* single-horse cart, though it is sometimes charged tenpence.

It is to be observed, that no certain data can be formed, as to the exact weight of dung *per* cart, without actual weighing, as the weight depends on many circumstances, such as the state of the dung in regard to putrefaction, its being in a dry state, or more moist, the size of the cart, and the dexterity of the carter in heaping more on, or tramping, or neglecting to do so.

It is usual to mix all the sorts of town dung into one compost, thirty single cart-loads of which is necessary for a potatoe crop *per* Scotch acre, in consideration of the future crops. The value of each cart-load may be estimated at 4 s., and consequently the expence of manure is, at the rate of L. 6 *per* Scotch, or L. 4, 16 s. *per* English acre, be-

sides the carriage, which in many cases equals the prime-cost.

Even ordinary farm-yard dung, before it is moved from the fold-yard, or the cow-houses and stables, ought to be carefully mixed, otherwise it can never be of equal quality. Mr John Shirreff is of opinion, that if the dung of cows and horses be spread over each other regularly as dropped, the whole mass will very soon be in a state sufficiently rotten for use. As straw, if rotted without a mixture of the excrement of cattle, makes a very weak manure, it is therefore proper to mix all the superfluous straw with what comes from the cattle.

It is much disputed, whether it is for the advantage of the farmer to give straw for dung, it being always understood, that the straw should be taken good care of, and not wasted. It is supposed, however, that unless the straw should happen to be very high priced, it is greatly for the farmer's interest to give straw for the dung, except he is under the necessity of carrying it to a great distance, for in this way he gets all the straw back again, made into good dung, with this great addition, that he also gets the dung arising from the hay and corn which the horses have made use of. The generality of farmers in the neighbourhood of the metropolis, however, afraid of being imposed on, sell their straw, and buy their dung at the market price.

On the whole, dung being the most essential ingredient for promoting fertility, the utmost exertion ought to be given, by every farmer, to collect it in as great quantities as possible, and to prepare it for use. Calcareous and other manures, in particular cases, are also necessary, especially for reclaiming land in high situations, or stiff soils; but animal and vegetable substances, when reduced to a putrid state, are peculiarly well calculated for recruiting exhausted land; and, if a sufficient quantity for that purpose could

be procured, the arable land in this island, might be made to produce triple the quantity it now does. How loudly does not this call for attention, not only to promote its increase, but to prevent its abuse, (both of which, in too many instances, are greatly overlooked), and to improve its quality. In some cases too much is applied, to the detriment of the crop, for luxuriance does not always insure a plentiful increase of grain, and much gain is seldom ultimately obtained by forcing crops.\* The loss generally sustained, however, is not from the application of too much, but of too little manure, as farmers are too apt to fritter away a quantity of dung over fourscore acres, without producing any sensible effect, which would have produced a valuable crop if confined to forty. Improving the quality of manure, is another most material object to be attended to. It is well known, that when cattle are fed and kept in a house, when they receive the same food in quantity and quality, that their dung becomes a more valuable manure, than what is made from cattle kept in a large open court. This arises, no doubt, from the cattle treading so constantly upon the dunghill, which consolidates it to such a degree, as to prevent the proper effects of fermentation. The latter mode, however, from requiring fewer houses, and giving less trouble, is very generally practised, though the dung is inferior in quality.

2. *Urine.*—This important article to the farmer, has only

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\* Baron Hepburn dungs lightly, and repeats it frequently. Virgil said long ago, that a large allowance of dung forced a great growth of straw; but he adds—“*Vanis illusit avistis—Siliquis fallacibus.*” In regard to the different sorts of dung, that from the hog is the strongest and richest, owing to the greater fatness of the animal. The dung of cattle is less transitory, and more lasting, than that of sheep. Horse dung is the most heating.

of late received that attention to which it is so justly entitled. Perhaps the urine of a horse, from its being so much lighter, is equally valuable as the dung he produces, more especially if both were to be conveyed to any distance; and it is calculated that the urine of twelve cows, is sufficient to top-dress two English acres of meadow: on the supposition, that an acre would require twenty cart-loads of dung at 5s. *per* cart-load, or L.5 *per* acre, the urine of each cow would thus be worth above 18s. *per annum*. Urine is advantageously employed, either by pumping it over the dunghill, or as a compost with peat, fine earth, or the refuse of the tan-pit. A plan has been adopted by Mr Charles Alexander near Peebles, for collecting urine, and preparing it for use, which it is proper to describe. He has made a pit, about twelve yards square, and four feet deep, which he fills with fat earth, carted from headlands, or wherever it can be got most conveniently, and levelled on the surface, so that the urine of the cattle he feeds, which is conveyed to the pit by a sewer, may spread equally over it. The edges are raised about six inches high, by a parapet of puddled earth, for preventing the urine from running over. The earth is carted to the compost pit in the summer, immediately after its former contents are applied to the turnips. The drier the earth is, when laid in, the better, as it imbibes more of the urine. After the compost has received the greatest part of the urine, which is about the latter end of April, (as at that time the feeding cattle are sold off), it is carefully turned over, when it shews symptoms of complete saturation. While the urine is applying, and the mass in a drenched state, there is little fermentation; but when turned over and laid dry, the fermentation of the mass is brisk, visible by its heat, and it is completely mellowed for laying on the turnips in June. In this way, Mr Alexander raises above 100 square yards of rich manure, and when applied to the ground,

finds its effect to be equal, if not superior, to his best dung. It is suggested, that covering the pit, so as to exclude the access of rain-water, and to prevent the exhalation by the rays of the sun in hot weather, would be an improvement on this plan.\*

Bones sprinkled with urine may be dissolved by the fermentation thereby excited, and if the same plan would answer with sea-shells, it would render that species of manure much more valuable, and more speedily efficacious.

3. *Lime*.—There is perhaps no country in Europe, where calcined lime is used to so great an extent, and in such quantities, as in the more improved and improving districts of Scotland. This may be partly owing to the total absence of chalk, which abounds in so many parts of England, and which renders calcined lime less necessary there; but it is principally to be attributed, to the great benefit that has been derived from its use. In bringing in new or maiden soils, the use of lime is found to be so essential, that little good could be done without it. Its first application in par-

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\* By some, this carting of the earth into a pit, and then out again, is objected to as likely to be attended with too much expence, and, at any rate, as practicable only to a small extent. It is therefore proposed, after ploughing the headlands, to cart the urine upon them, and then to remove the soil to the field as a top-dressing, or for turnip drills. Mr John Shirreff thinks that it would be a better plan to run the collected urine weekly over the surface of the dung-heap. Nothing tends more to promote the preparation of dung, or to make it richer, than urine. The whole mass might thus be brought, at an early period, into a state completely prepared for use, which cannot be expected so soon, if it ever arrives at such a state, when deprived of so essential an ingredient. Mr Curwen pumps urine from pits, on his dung, and carts it off every six weeks, in a state of maturity, ready to be laid upon the land, covering it with earth, till laid on.

ticular, gives a degree of permanent fertility to the soil, which can be imparted by no other manure. Its effects, indeed, are hardly to be credited, but their correctness cannot be disputed. Maiden soils, in Lammermuir, of a tolerable quality, will, with the force of sheeps' dung, or other animal manures, produce a middling crop of oats, or rye; but the richest animal dung does not enable them to bring any other grain to maturity. Peas, barley, or wheat, will set out with every appearance of success, but when the peas are in bloom, and the other grains are putting forth the ear, they proceed no farther, and dwindle away in fruitless abortion.\* The same soils, after getting a sufficient quantity of lime, will produce every species of grain, and in good seasons bring them to maturity, in all future times, always supposing the ground to be under proper culture, and the climate adapted to the crop. This fact proves, that oats and rye, require less calcareous matter than what is necessary for other grains; that lime acts as an alterative, as well as an active medicine, and that the defects in the constitution of the soil are cured, even after the stimulant and fertilizing effects of the lime have long ceased to operate. Lime is also peculiarly beneficial in improving muirish soils, by making them produce good herbage, where nothing but heath and other unpalatable grasses grew formerly. The expence of this article in Aberdeenshire is stated to be enormous, very little of it being produced in that country; yet lime is there considered to be absolutely necessary, and, indeed, the foundation of all substantial improvements.† It is

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\* Marle, although containing calcareous matter, is not so effective. It will produce oats, barley, and early peas in abundance, and in some situations will also produce wheat, when the season is favourable, but wheat crops cannot be depended upon from marle alone.

† Communication from Mr Barclay, Mill of Knockleith. It is obser-

supposed, however, not to be so useful on the sea-shore, as in the more inland districts, from the soil being perhaps mixed with sea-shells.

The importance of lime as a manure, is strikingly exemplified by the following information from Mr Walker of Mellendean: He entered into the possession of that farm twenty-five years ago, and then gave the whole farm, (with the exception of a few acres of the *richest soil* in different fields, which had for ages been manured as infield), a good dose of lime. From the newly-limed land, his returns were fully equal to his expectations, and greatly superior to those from the richest spots that had received no lime. Being very desirous to ascertain how long the limed land would maintain its superiority, he kept both the limed and unlimed, under the same management in every respect, during his first lease of twenty-one years; and he can affirm, that at the end of that period, his crops upon the limed land were equally good, and as much superior to those of the unlimed land, as they were at the commencement thereof. Having got a new lease of that farm, he proposes laying lime upon every spot of ground that was not limed formerly, being convinced that he has been a considerable loser by his experiment. How long therefore the effects of lime may last, he will not take upon himself to foresee; but he can safely say, that there is land upon his brother's property at Wooden, that was limed by his father upwards of thirty years ago, where the effects of the lime, upon every crop, are still as apparent, as when it was first laid on the land.

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ved, that lime has sometimes been withheld both from low lands after fallow, and from hilly lands after turnips; but in all these cases, with an evident loss to the occupant, by a decrease of produce throughout the whole course.

It is proposed, in discussing this subject, very shortly to explain the following particulars: 1. The soils to which lime is applicable; 2. The distance from which it has been carried; 3. The quantity used; 4. The best mode of slack-ing; 5. The common modes of application; 6. The plan of top-dressing the surface; 7. The price; 8. The use of pounded limestone; and, 9. The causes which may occasion its failure.

1. This manure is certainly well calculated for clay lands. Some recommend laying on a certain quantity of it, to the amount of 20 bolls of shells, or 120 bushels, to the Scotch, or 96 to the English acre, and as hot as possible, every time the land is fallowed. This plan, however, is objected to from respectable authority, and it is contended, that so small a quantity of lime shells, is quite unfit for stimulating any kind of soil, except where it is of a dry muirish nature, and not formerly limed. To lime land every time it is in fallow, seems unnecessary, more especially if a sufficient quantity were applied in the first instance.\* From 60 to 70 barley bolls *per* Scotch acre, or from 360 to 420 bushels *per* Scotch, that is, from 288 to 336 bushels *per* English acre, are quantities frequently given in East Lothian. In regard to loams, if they are in good condition, and in good heart, perhaps liming once in the course of two rotations will be sufficient.† It is a rule, however, in regard to the application of lime, and other calcareous manures, that they should only be applied to land in a dry state, and well drained.

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\* Mr John Shirreff remarks, that to specify a quantity for all lands is impossible, so much depends upon the depth and quality of the soil; also on the quantity of calcareous matter, either previously applied, or originally in the soil.

† Communication from George Paterson, Esq. of Castle-Huntly.

2. It is astonishing the distance from which lime is carried in some parts of Scotland. Mr Blackie of Holydean, in Roxburghshire, drives it twenty-two miles, and the carriage, when hired, is 7s. 6d. *per* boll of shells. In the parish of Moffat, where of late considerable improvements have been carried on, and corn, turnips, and clover, raised in great perfection, 1000 feet above the level of the sea, the lime is carried from Douglas, at twenty-seven and thirty miles distance. It is sometimes carried on the borders, but in no great quantity, about thirty, or even thirty-two miles;\* and in Aberdeenshire, it is driven that distance inland, after being imported from Sunderland.

3. The quantity used varies much. It is evident that strong deep soils require a greater quantity than those which are light and shallow. Baron Hepburn is of opinion, that it should be applied frequently, and in small quantities at a time, especially on gravelly-bottomed loams, which are apt to become too open and pliable by an over dose of lime : by following this practice, he finds his crops wonderfully improved, both in regard to quantity and quality. Mr Robertson of Ladykirk states, that he has never seen lime used in too great a quantity, if the land is judiciously cropped ; if otherwise, it will ultimately hurt the soil. He has laid on no less a quantity than 100 bolls of shells, 4 Winchester bushels each, *per* English acre, and frequently with much success. On dry fresh land a less quantity will do. Mr Blackie of Holydean considers 16 bolls of shells, on such land, a sufficient dressing. Dr Coventry is of opinion, that in general, about 6 tons of unslacked or newly-burnt lime, of ninety or ninety-five *per cent.* of purity, may be sufficient for the statute acre of land that has

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\* Communication from Mr Walker of Mellendean.

never been limed; but if the lime be impure, a greater proportion will be requisite. Several intelligent farmers are of opinion, that not less than 60 or 70 bolls of lime shells *per* acre, should be laid on a strong clay soil, and that this quantity, with judicious cropping, will be sufficient for a lease of 19 or 21 years.

The information transmitted to me by Mr Walker of Mellendean upon this subject, is of peculiar importance, as he has limed perhaps more land than any individual in the whole island, and in the course of thirty years has tried various experiments in regard to the quantity that should be applied *per* acre. On newly-broken-up land from old turf, he has laid on from 20 and 25 to 40 and 45 bolls of shells, of 4 Winchester bushels each, *per* English acre. On light and thin (outfield) soils, the crop on that part of the field that was limed at the rate of 20 and 25 bolls *per* acre, was as rough, and appeared equally good, with the crop on the land that had received 40 bolls *per* acre; but when it came to be threshed out, the grain was found very inferior in quantity, and still more so in quality. Upon clay soils, the effects of the lime, where a small quantity was laid, were hardly discernable; while that part of the field that received 40 and 45 bolls, produced an abundant crop. Finding the produce of the land that was limed with a small quantity so very inferior, he laid on, (when the land came to be re-fallowed), 20 or 25 bolls more, the effects of which were never perceptible. He is therefore decidedly of opinion, that every kind of soil should have a good dose at once, in which case he considers no repetition to be necessary for a long time after; but if repeated at all, the second liming should be considerably greater than the first, which seems to be the general opinion of the Scotch farmers. As to repeated liming in small quantities, Mr Walker is convinced, that whatever is laid out in that way, after the first dose, is

so much money thrown away. He can give no stronger proof, of his conviction in that respect, than his practice upon the farm of Rutherford. He entered to that farm in June 1808, and since that time he has gone over about *eight hundred and fifty acres*; and though a great part of it consists of a light dry soil, and the lime has to be carried twenty-four or twenty-five miles, consequently at a great expence, yet on no part of the farm has he laid less than 40 bolls of shells, or 240 Winchester bushels *per* English acre, and on many places fully 50 bolls. Nothing, in his opinion, assimilates the produce of outfield, to that of in-field land so much, as a good dose of lime laid on at once. The consequence of this liming has been, the most productive crops, of every description, to be seen in all that neighbourhood.

Mr Aitchison of Clements Wells also has found that lime answers every purpose he could wish, in promoting the improvement of his estate in Peebles-shire, where the climate is cold and moist. He began to improve that property in 1806, and in October 1811 he had laid on it, 10,386 bolls, or 62,316 Winchester bushels. His ridges are 18 feet broad, and according to the quantity he wishes to put on *per* acre, his overseer has the following table to conduct the operation.

If it is proposed to lay on 25 bolls <i>per</i> acre, betwixt each heap, of one firloft each, there ought to be a distance of	-	-	-	-	30½ feet.
If 30 bolls,	-	-	-	-	25½
35 do.	-	-	-	-	22
40 do.	-	-	-	-	19
45 do.	-	-	-	-	17

And in the same proportion as high as 50 bolls. He never puts on less than 25 bolls, or 150 bushels of shells, *per*

Scotch, (130 bushels *per* English acre), and on heavy land he has gone the length of 70 bolls. The day the lime comes to the field, a man follows the carts, and covers it up immediately with earth, by which, generally in a few days, it is reduced to powder. When in that state, it is spread on the land. After trying several other methods this was found to be the best. The improvement effected by lime on that property has been very great.

4. The slacking of lime completely is a most important operation. The common mode is, to lay it in heaps from the kiln upon the ground intended to be limed; but this, although the most expeditious, is by no means the most advantageous method. In the first place, if the lime is not all of the same quality, (which is seldom the case), the best lime commonly dissolves first, and the inferior quality continues unslacked; so that it must either be spread in that state, or the good lime must be allowed to receive too much moisture, or again to re-absorb its fixed air, both of which should be prevented. The best mode of slacking, is to lay down the shells in a heap near to water, and by once turning and watering the whole mass, it is reduced to a complete powder; in which state it should be applied to the soil, and ploughed in immediately with a shallow furrow, when there is no doubt but it will mix more intimately with the soil, than by the former method.\* This plan, however, is attended with an additional expence of considerable magnitude.

The necessity of slacking calcined lime, as soon after it is burnt as possible, is obvious. If any sudden rain should fall, it would be converted into mortar; no art can then separate it, and mix it equally with the soil; nor would double the quantity have the same good effect. Even after

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\* Communication from Mr Rennie of Kinblethmont.

it has been reduced to powder, if any rain should happen to fall, or if by any means it receive too much moisture, while it lies thin spread on the surface of the field, it will partly be formed into hard insoluble cakes, and may remain in that state for years, without mixing with, or being of the least benefit to the soil. In the course of repeated ploughings, Mr Paterson of Castle-Huntly has observed pieces of hard lime come up, as insoluble, as if they had been pieces of an old building.

Considering these circumstances, I was much pleased to find, that a mode had been discovered by Mr Niel Ballingal in Fife, which obviates these difficulties. His plan is, to lay the calcined lime down on any thick head-ridge of good earth, within the field where it is to be applied, and the instant it is so, two men are ready to make up a compost of the lime-shells and earth; three cart-loads of earth to one cart of shells, raised to a ridge long and narrow, five feet high, that rain may not enter it. The moisture in the earth, slacks or reduces the lime to a powder; it swells to a considerable bulk, and then all cracks and openings are closed with a spade, and a little more earth put over the whole. In this way, he has had it frequently mixed up for six months, and in one particular instance fifteen months, before it was carted away; and yet when carried on to the land and spread, the whole mass put on the appearance of white lime, flying with the wind, as if newly from the kiln. This mode he means always to follow, being certain of its advantage. It can be mixed as intimately with the soil as if new from the kiln, and he has had crops from it in this way, superior to an equal quantity of hot lime,\*

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\* This is an important fact, it being generally supposed that when inserted in the form of hot lime, in a state of perfect powder, its effects

both tried without dung. The application commonly is to the summer-fallow: he has also applied it to pasture, quite hot, and in compost as above described, and found both answer well; but the time of application was July, and he soon found, that it ought to lie at least one year or more before the field was ploughed.

Mr Ballingal having used from 500 to 1000 bolls *per annum*, for several years, his experience may be confidently relied on. He remarks, that lime, if exposed to rain, or even to frost, and slacked like mortar, loses half its effect; no care can then mix it intimately with the soil. His land is wet, and often when the lime is driven, unfit for carting upon the field, nor are the ridges prepared for spreading the lime; without having fallen upon such a plan, therefore, he could never have used lime to equal advantage. He adds, that an intelligent neighbour of his, brings his lime from the kiln, lays it in small heaps, about a firloft of shells in each heap, or four heaps *per boll*, on the fallow; covers these instantly with earth, which slacks the lime, and when it is completely so, he spreads it in powder, quite hot, on the fallows, and ploughs it in with a light furrow. This saves labour and expence. He never uses water in slacking lime, and the effects of his practice are very good; the earth, or rather the moisture in it, slacks the lime most completely, and no water is necessary.\* This is an ex-

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are greater and more immediate than in any other way. By Mr Ballingal's plan, the lime can be carried to the field in autumn, or even in winter, which, though an old practice, could not be done with equal safety, as under the proposed system.

\* A correspondent contends, that lime is best laid on the land in small heaps, and immediately covered with earth, which in a damp or

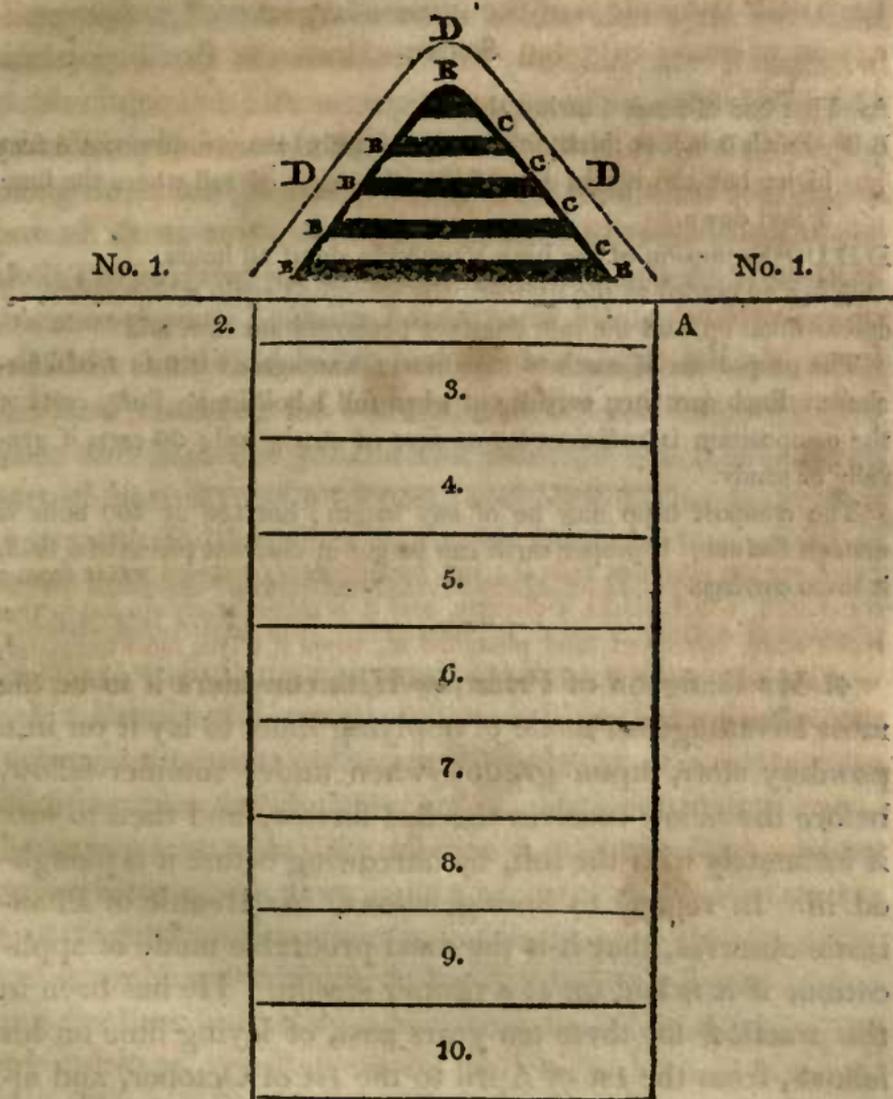
cellent practice, and very common in many counties : and many intelligent farmers prefer it to the other plan, which they think would be attended with too much expence to be generally imitated. At the same time, an intimate mixture with the soil, is of the utmost importance in the application of lime; any plan that contributes to that object merits attention.

Having often heard farmers complain of the difficulty they experienced, in procuring water, in sufficient quantities, thoroughly to slack their lime, in some districts; and in others, of the loss they sustained in carrying on their lime husbandry, by unexpected rains, I have procured, from Mr Ballingal, the following sketch, which, with the references thereto, will fully explain his system.

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moist season slacks or falls it; but he frequently puts on water from a water-cart, which slacks it directly, and it is immediately spread in that quick state, harrowed, and ploughed in, when it mixes most intimately with the soil. Lime should be in powder, and the land in a powder-like state, when it is laid on.

*Plan of a Heap of Earth and Lime, in alternate strata, as practised by Mr Niel Ballingal in Fife.*



*Reference to the Plan and Section of the Compost Midden.*

No. 1. 1.—Surface of the ground.

No. 2.—A small trench made under the surface, afterwards filled with lime 4 inches deep.

No. 3.—First space dug out equally deep as No. 2. the earth of which is thrown back, and left to cover up the end of the heap when completed.

No. 4, 5, 6, 7, 8, 9, 10.—Similar trenches, 8 feet by  $3\frac{1}{2}$ .

### *Section.*

A—First bed of lime, 4 inches thick.

B B—Earth 6 inches thick alternately with C C lime, until about 5 feet high; but the height depends on the depth of soil where the lime is laid down.

D D D—Expansion of the heap after lying about 48 hours.

When expanded to the utmost, it is smoothed again with a spade, all cracks filled up, and the rain does not penetrate but runs off.

The proportion of earth to lime most advantageous is 3 to 1 of lime-shells. Each cart then carries out when full 1 boll lime. Forty carts of the composition is sufficient for an acre of strong soil; 30 carts if gravelly or sandy.

The compost heap may be of any length; but 150 or 200 bolls is enough for one. If proper earth can be got in different places of a field, it saves carriage.

4. Mr Dudgeon of Primrose-Hill, considers it to be the most advantageous mode of applying lime, to lay it on in a powdery state, upon ground when under summer-fallow, before the fallow receives the last furrow, and then to mix it intimately with the soil, by harrowing before it is ploughed in. In regard to liming fallows, Mr Rennie of Phantassie observes, that it is the most profitable mode of application, if it is laid on at a proper season. He has been in the practice, for these ten years past, of laying lime on his fallows, from the 1st of April to the 1st of October, and always found, that the first laid on produced the best crops, which he ascribes to its being more minutely mixed with the soil, by the more numerous ploughings and harrowings, and of course the fermentation more complete, than what is laid on late in the season: June and July, therefore, are

to be preferred, so that the lime may be completely mixed with the soil before the crop is sown; and as it is both a valuable and expensive manure, too much attention cannot be given it.

Applying lime to green crops is attended with more difficulty. From observation and practice, Mr Rennie recommends, that, for a crop of turnips, lime should be laid on so early in the spring as to admit of two, if not three ploughings, and as many harrowings, after it is laid on, so as both to mix it properly with the soil, and also to let it have time to cool in the land, otherwise it will be very apt to cause the loss of the turnip crop.

Mr Park of Windy-Mains is accustomed, to lay lime on the land intended for turnips, immediately after harvest, when the land has got the first furrow. He first makes a pair of harrows go backward and forward on each ridge to smooth it, then lays down the shells in huts about 60 or 80 bolls *per* acre Scotch; as soon as it is powdered, he spreads the huts, and harrows the field, and lets it remain till May, when it may be prepared for receiving the dung.

Mr Brodie of Garvald, who has long paid peculiar and successful attention to the management of lime, adopts the following plan in applying lime to his turnip land. After the ground intended for turnips has got a winter and a spring furrow, the lime is laid on, and well harrowed in: it then gets another furrow before making up the drills, and is again well harrowed, for the double purpose of getting the lime intimately mixed with the soil, and taking out any quickens, or other weeds, by which the field is infested. The turnips are sown in drills, both as being better for the turnip crop than when sown broad-cast, and the lands are got better cleaned, either from annual or perennial weeds. It is reckoned an advantage, to have the lime got forward during the former summer, previous to its be-

ing laid on for turnips; for on a turnip farm, there is so much spring labour, that it is hardly possible to drive any considerable quantity of lime, from any distance, at that season of the year. When it is new from the kiln, it is so hot, that it is apt to dry up the moisture necessary for bringing the turnips into leaf; in this case, the lime ought to be laid on a piece of very dry ground, in large heaps, and thrown up to a considerable thickness, which will make it in a fine state for laying on in the spring, that is, neither in a wet, or in a very hot state.

In regard to green crops, Mr Paterson of Castle-Huntly thinks it better to lay on the lime after the green crop, rather than before it, so as it may be well mixed with the soil, before it comes in contact with potatoes or other roots, it being apt to burn and blister their skins, and to spoil their appearance, if it does no more mischief. Some farmers, however, have put lime upon the ground after it is planted with potatoes, and harrowed it in. But this practice cannot be recommended.

The application of lime to grass, particularly on light or dry soils, and where the land has been long pastured, is a most advantageous system, if it is soon after to be brought into culture; otherwise, being exposed to the atmosphere, with but little admixture with the soil, it cakes and hardens, and in some measure re-assumes that unproductive quality, which it possessed, previously to its being reduced to a caustic state. It may be applied after the land has been a summer in pasture, or cut for hay; but the ground should be made as bare as possible, otherwise it will be difficult to spread it equally over the sward or surface. The lime should be laid on in autumn, and the land should remain in grass for another season, till it is absorbed. If intended to be applied to old ley, either lay the lime on one year before cropping, letting it lie upon the surface, or lay it

on about Martinmas, and let it lie on the surface till February, then plough it down, and sow the ground when the weather is suitable. Suffering ground to remain for some years in grass, is certainly the best preparation for lime, as it has then fresh mould, and vegetable matter, to act upon.

Mr Cuthbertson recommends, that no lime should be laid on high ridges that are intended to be flattened; the ridge should be brought to the same round in which it is intended to remain, before that operation is accomplished, because, in performing it, there is a great risk of burying the lime. Mr Barclay remarks, that when the application is made, the land should not be too wet; and it is necessary at all times, to have the lime brought to such order, as neither to fly off with the wind, nor go into clods in the spreading.

Mr Brodie of Garvald observes, that some speculative agriculturists recommend liming upon the surface, to extirpate the heath, and improve the pasturage, without attempting to bring ground under the plough, as the soil and climate may be unfit for the raising of grain. If the lime is at any considerable distance, there is reason to suspect that this would not turn out a profitable concern. At the distance of eight or ten miles, a good liming would not cost less than L.10 or L.12 the Scotch acre. It cannot be expected that this improvement, on such hills as those of Lammermuir, would even pay the interest of the money. Gentlemen proprietors may improve at this rate, but a tenant would be extremely imprudent, were he to throw away his capital, without a prospect of being repaid. It is surely better to lime land worth the improving, to bring it under the plough, and then to take a few corn crops to refund the expence. The tenant is thus reim-

bursed, and has an ameliorated pasture, as the reward of his industry and superior management.

Though liming the surface, "to extirpate heath, and improve pasturage," may not be a profitable concern on old swards, it is proper to observe, that when land is broken up, merely for the sake of improving the pasturage, the best, and most economical mode is, to apply lime to the surface, and to harrow it along with the grass seeds. A great extent of hilly pasture, has thus been improved by Mr Dawson, and others, in Roxburghshire.\*

6. Mr Kerr, the intelligent reporter of the Husbandry of Berwickshire, has transmitted to me the following calculation of the expence of liming. The lime he used was brought by sea to Eyemouth; and the price, besides carriage, amounted to 25d. *per* boll, in shells, each boll containing four Winchester bushels; hence to lime an acre of land with 35 bolls, will cost about L. 3, 15s., besides carriage and spreading, which, the distance being short, may amount to 10s. more, or L. 4, 5s. *per* acre; and as this operation was usually repeated twice during a lease of nineteen years, liming, in his situation, may be considered as a yearly charge of 10s. *per* acre.

How astonished would not many farmers be in other countries, when they hear that Scotch farmers, subject themselves to an expence of 10s. *per* acre *per annum*, for lime alone, a sum not much inferior to the average rent of land in many English counties. But the expence is well bestowed, were it only from the benefit thence to be derived in the cultivation of green crops of every description. For though such crops can be raised by large quantities of

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\* For a detailed account of this excellent method, as practised by Mr Dawson, see the Farmer's Magazine for March, 1812.

dung, yet where calcareous substances are applied, as Mr Brodie of Garvald has found by long experience, a less quantity of animal manure will answer the purpose. This is making the farm-yard dung go farther, with more powerful and more permanent effects; and from weightier crops being thus raised, the quantity of manure on a farm will be most materially augmented.

7. The use of pounded limestone, where fuel is scarce or dear, was strongly recommended by Lord Kames. He observes, that three pounds of raw lime is, by burning, reduced to two pounds of shell lime, though nothing is expelled by the fire but the air that was in the limestone, the calcareous earth remaining entire. Two pounds of shell lime, therefore, contain as much calcareous earth, as three pounds of raw limestone. Shell lime of the best quality, when slacked with water, will measure out thrice the quantity: but as limestone loses none of its bulk by being burnt into shells, it follows, that three bushels of raw limestone, contain as much calcareous earth, as six bushels of powdered lime; and consequently, if powdered lime possess not some virtue above raw limestone, three bushels of the latter, *beat small*, should equal, as a manure, six bushels of the former. These suggestions, however, have not been acted upon, probably owing to the difficulty and expence of beating the limestone sufficiently small. At the same time, the advantage derived from the use of limestone gravel in Ireland, is, however, highly favourable to Lord Kames's doctrine.\*

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\* It would be extremely desirable to ascertain, whether limestone gravel might not be found in Scotland; to the discovery of which, I hope the attention of that public-spirited institution, the Highland Society of Scotland, will soon be directed.

8. It is an ascertained fact, that lime is of no advantage in the neighbourhood of Edinburgh, where the land has been long accustomed to aration and city manure. Mr Allan of Craigrook, near Edinburgh, has given lime the fairest trial, by liming one ridge, the whole field over, at the rate of 60 bolls *per* acre, and leaving the other unlimed, and he has uniformly found, that the liming has had no effect. The reason, probably, is this, that the land having been so often manured with Edinburgh street-dung, which frequently contains a proportion of shells, the use of stone lime is thereby superseded. Indeed, some are of opinion, that the land in the immediate vicinity of Edinburgh, had been abundantly limed at some former period, which, in addition to the calcareous matter mixed with the street-dung, renders any additional liming unavailing.

Mr Hume of East Barns finds, that lime does not answer on his farm near Dunbar, which he attributes to the great quantities of sea-ware, mixed with shells, which have been laid on these lands from time immemorial, and their having been formerly under constant crops of corn, and never in grass till lately, and even now only one year at a time. It is well known, he adds, that lime acts best on land that has been much in grass. Any local circumstances of that sort, however, cannot diminish the credit of a manure, of such essential importance to the improvement of the country.\*

4. *Marle*.—In the improved districts of Scotland, lime

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\* It is an interesting object of enquiry, whether lime is equally efficacious on the sea-shore, as in the inland districts? It is well known that gypsum is not. Sea-ware contains kelp, which, from the alkali it possesses, may act as a substitute for lime.

is much more in use than marle, and hardly any observations have been transmitted to me regarding this branch of the enquiry. One intelligent correspondent, (Captain John Henderson), recommends it as a good mode, to apply it upon the hay-stubble, after the first crop; if the marle is thus used, the land should be pastured the next season, and afterwards ploughed down either for oats, or for wheat, in districts where that grain thrives. At any rate, it should be allowed to *batter* on the surface, previous to its being ploughed down, to prevent its falling down to the bottom of the furrow, as the land falls from the plough. Dr Coventry remarks, that the value of most marles, is nearly in proportion to the quantity of lime, or calcareous earth, in their composition, taken in conjunction with their distributability, or the ease and completeness with which they may be mixed with the soil. Hence it happens, that though nine tons of the carbonate of lime in marle, would be much the same with six tons of unmixed lime, yet the impure marle, when fully broken, being more distributable than lime, especially if it be imperfectly slacked or at all clotted, perhaps a quantity of that marle, containing seven tons of the carbonate of lime, may be of equal value, as a manure, with the other—the six tons of lime. Clay marles, however, are often very weak and impure; hence it often requires sixty, and, in some cases, even eighty tons of marle, to supply seven or eight tons of the carbonate of lime. Where that happens, lime itself is undoubtedly, in many respects, the cheaper and preferable article.

5. *Sea-ware*.—The importance of this manure, when it can be had near at hand, and in considerable quantities, is very great. It is calculated, that land possessing this advantage, is worth more rent, to the amount of from 10s. to even 15s. *per acre*, for the land that possesses it. Tan-

gle, or drifted sea-ware, has been spread on old grazing pastures, and has had a wonderful effect in increasing the quantity of herbage, and in making the land eat cleaner. It acts as a condiment, for both cattle and sheep not only eat the grass on which it has been spread with avidity, but throve well, and were made sooner fat.\* Mr Newton of Cartlandhill, near Inverkeithing, mixes it with long dung, and finds that it makes a most excellent compost. The ware, however, in that part of the frith, is of a weaker sort, and has less saline substances in it. When of a more powerful description, it should never be used as a compost, but laid fresh on the land. If there is no land under the plough ready for it, let it be put on grass lands, but in that case great care should be taken to lay it thin, otherwise it will kill the clover plants.

On some farms near Dunbar, the land is covered with sea-weed every second year, which enables it to go through that severe rotation, 1. Turnips; 2. Spring-sown winter wheat; 3. Clover, either cut or made into hay; and, 4. Wheat again. It is only, however, by the farmers having such a command of manure, eating the turnips on the ground, and drilling and hand-hoeing the wheat crops, that such a system could be persevered in. For the second wheat crop it answers extremely well, to apply the sea-weed early in spring, on the grass to be cut, if it is laid on in dry weather. Sea-weed should never be applied on ground for turnips after March, as it seldom incorporates with the

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\* Another of my correspondents states, that he has had sea-ware spread on old pastures; that it produced a great quantity of grass, but the cattle, he observed, were not fond of eating it. Perhaps it had grown too rank before the cattle were put in, and it ought to have been cut for hay.

soil in such a way as to insure a good crop, and if the weather is not moist in the summer, it is probably one cause of breeding the fly, so destructive to turnips.

6. *Composts*.—Some farmers think that composts of earth, with either lime or dung, are too expensive; requiring much time before they can be applied; troublesome to carry and to spread; and where the price of labour is high, not likely to pay. They prefer, therefore, putting on any good earth by itself, that may be found about the farm. Such compounds, however, when properly applied, have their advantages; in particular, when they are laid on, 1. Muirish lands, and, 2. Fallows, or grass fields. It is indeed completely ascertained, that lime will operate on muirish soils, when mixed with earth as a compost, though it will have but little effect, when applied by itself, operating at least on the earth with which it is mixed.

1. Mr Hope of Fenton informs me, that he had on his farm fifty-two acres of muir land. His system was, to summer-fallow, to dress it as much as possible with a compound, made with the scourings of ditches, high head-ridges, and any spare earth he could find on other parts of his farm; by which means he has gone over nearly the whole fifty-two acres twice during the last eight years, at the rate of sixty double cart-loads each time *per acre*; and now, as the nature of the soil is much improved, he finds that farm-yard dung can be applied with far greater advantage, than before the application of the compound dung-hills; the soil having become much firmer, therefore stands the summer's drought better, which frequently before burnt up the crops, although well manured. After the summer-fallow, he never sows wheat in winter, as he has repeatedly experienced, that after this muirish kind of soil has been wrought very fine in summer, from its being incumbent

upon a bottom so extremely retentive of moisture, a great part of the plants were completely destroyed in the spring; he now, therefore, always sows in the spring, either wheat, barley, or oats, as circumstances permit; along with this crop, he sows grass seeds; allows the grass to remain one, two, or three years, then oats after the grass, which finishes the rotation.

This is evidently a most material improvement, altogether founded on the use of *compound dunghills*, by which a soil was in a manner created or manufactured, so as to render it fit, from its texture, to retain moisture and manure, two of the principal sources of fertility.

2. Many farmers apply composts to fallows, more especially when the soil consists of thin clay, (in which case the effort it makes is very great), or when the quantity of lime or dung is inconsiderable. The compost should be well mixed and broken, spread on the ploughed surface of the fallow, and ploughed in. The fallow should get two ploughings, besides harrowings, after the compost is laid on, that it may be well mixed with the soil before the crop is sown.

3. Composts are peculiarly calculated for top-dressing grass fields, if to remain in that state for some time, for pure dung is apt to evaporate, and to lose all its substance. When composts are put on grass fields, at the rate of about sixty cart-loads *per acre*, about the month of February, their effects are very great.

On the subject of composts, the following additional particulars remain to be explained.

Where no moss or peat earth can be procured, it is an excellent practice, when the head-ridges, (on which the plough turns, and where of course much rich earth must be deposited), get high, to take off about a spade deep, and to lay it up with dung and lime during the winter, to

be used in spring as manure, for the barley or oats intended to be laid down with grass seeds. Mr Hunter of Tynefield, however, is of opinion, that hand labour, in every case of turning and preparing composts, is too expensive, and thinks it better, where any depth of soil has accumulated on the head-ridges, to turn it with the plough, after harvest, and to mix about sixteen bolls of lime shells, with about 150 yards of earth, which is sufficient to manure an acre.

Mr Laing of Campend, near Dalkeith, is of opinion, that by making composts judiciously, the fertilizing powers of dung or lime may be increased, in the ratio of one-fourth, or that instead of twenty, by judicious management, twenty-five acres may be manured with the same quantity of dung; for that purpose he proposes to collect cleanings of the road, scourings of the ditches, or accumulated earth on head-lands, with as much dung as will raise a fermentation or heat in the dunghill, turning it over for a few weeks before driving, that it may be thoroughly incorporated.\*

Mr Dudgeon of Prora observes, that compounds of all kinds are valuable; they so act upon one another in the

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\* Mr Laing very strongly recommends, when wheat is sown with one furrow after grass, (which in most soils is a very precarious and uncertain crop), manuring it with dung or lime compost, after being ploughed, as it would derive great benefit from the carting consolidating the soil; for in ley wheat, very often there is a vacancy between the furrows, from which the plants die when they are extending their roots for food, which the carting and treading of the horses would in a great measure prevent. The advantage of treading wheat land, has long been known in England, and should be secured, as often as the circumstances of the case, and the pressure of labour, at the busy seasons of the year, will admit of it,

mass, that the chemical properties of the whole are changed so as to render it efficient as a manure. Earth and lime make a good compost, and when the lime is applied in its ordinary quantity, in addition to the earth, the effects are truly astonishing. It even produces good crops, though no more than the one half of the usual quantity of lime is applied.

*Recent Improvements in Manures.*—Three improvements have recently been discovered in Scotland, in the art of preparing manures, of which it may be proper to give some account in this place; namely, 1. Lord Meadowbank's; 2. Dr Rennie's; and, 3. Mr Mitchell's.

1. In various parts of the Highlands and islands of Scotland, it is not unusual to bed the cattle with moss or peat earth, for the purpose of increasing the quantity of manure; but Lord Meadowbank certainly was the first, who investigated that species of manure, on scientific principles, and communicated the result to the public. By his plan, one ton of dung will ferment three tons of moss earth, which is certainly a most valuable discovery, and must, if duly attended to, greatly enrich many hitherto neglected districts.\* Mr Thomson of Bewlic, in Roxburghshire,

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\* See Mr Aiton's Treatise on Moss Earth, printed in 1809. The following is the process recommended by Lord Meadowbank:

The moss and dung must be thrown up in alternate strata into a compost midden, about four feet and a half high. Moss may be laid six inches deep, dung ten inches; moss six inches, dung four inches; moss six inches, and then a thin bed of dung; and cover the whole with what remains of the moss. The heap should be put loosely together, and made smooth on the outside.

The compost, after it is made up, gets into a general heat, sooner or later, according to the weather, and the condition of the dung; in summer, in ten days or sooner; in winter, not perhaps for many weeks, if

informs me, that he has had the experience of this compost for five years, to a very considerable extent, and has found it to answer. In making compost dunghills, he has, as nearly as possible, followed Lord Meadowbank's directions; but when he has plenty of dung, he puts only two,

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the cold is severe. It always, however, has been found to come on at last; and in summer it sometimes rises so high as to be mischievous, by consuming the materials (*fire-fanging*). In that season, a stick should be kept in it in different parts, to pull out and feel now and then; for if it approaches to blood-heat, it should either be watered or turned over; and, on such an occasion, advantage may be taken to mix it with a little fresh moss. The heat subsides after a time, and with great variety, according to the weather, the dung, and the perfection of making up the compost, which then may be allowed to remain untouched, till within three weeks of using, when it should be turned over, upside down, and outside in, and all the lumps broken; then it comes into a second heat, but soon cools, and is taken out for use. In this state, the whole, except bits of old decayed wood, appears a black free mass, and spreads like garden mould. Use it weight for weight like farm-yard dung, and it will be found, in a course of cropping, fully to stand the comparison.

Let it be observed, that the object of making up the compost, is to form as large a hot-bed, as the quantity of dung employed admits of, and then to surround it on all sides, so as to have the whole benefit of the heat and effluvia. Peat, nearly as dry as garden mould in seed-time, may be mixed with the dung, so as to double the volume and more, and nearly triple the weight, and instead of hurting the heat, prolong it. *Prize Essay, by Lord Meadowbank, pages 149, 150, and 151.*—This manure succeeded with Mr Dudgeon, Prora, beyond expectation, on fallow for wheat; and with twenty carts *per acre*, in place of twelve of farm-yard dung, has been completely equal to it. But there is reason to believe, that merely for want of attention, and allowing it to be too much heated, the plan has sometimes failed, and in such cases has got a character it did not merit. A correspondent states, that he has used this compost for seven years, and considers it to be of immense importance. He would rather bring moss for two or three miles, than want it for his compost dunghills.

or two and a half cart-loads of moss, instead of three, to one cart-load of dung. From this compost, he has raised as good turnips as from dung alone, and from it has raised as good crops of wheat after fallow, to the extent of forty or fifty acres *per annum*, as from dung. He has on his farms plenty of moss, and when it is within reach of arable land, he can from experience recommend the moss compost, as a great acquisition to farmers.

2. Dr Rennie of Kilsyth has paid particular attention to moss-earth as a manure, and has discovered a very simple process by which it can be rendered valuable. He proposes, that it shall be laid alongside of a pool formed for receiving the juice of the dunghill. For ten days it ought to be saturated with that liquid, occasionally turning it during the process of watering; it should then be allowed to lie in a thick heap, and to acquire a very gentle, almost an imperceptible degree of fermentation, after which it is fit for application. By the abstraction of its juices, however, it is evident, that the dunghill would be greatly deteriorated.

As connected with the subject of peat as a manure, it may be proper to remark, that Mr Church of Hitchill strongly recommends what may be considered as a recent improvement in Scotland, namely, the use of peat-ashes as a manure for turnips. They should be burnt in the Berkshire mode, and though the ashes are said to be a manure of only short duration, yet Mr Church has had satisfactory experience of the advantage to be derived from them. If by their means a good crop of turnips can be obtained, and afterwards eaten off by sheep, the land will thus be as much enriched, as if the turnips were grown from farm-yard manure. Putting on as many ashes as just to cover the surface, will secure a good crop. When peat is plentiful, this is an object well worth attention.

4. One other improvement in the preparation of manure

remains to be described. It is a discovery made by Mr Mitchell, surgeon at Ayr, which both the inventor, and others in his neighbourhood, have tried with the most beneficial effects. The following description of the process is given by Mr Mitchell: "Take thirty-two Winchester bushels of lime, and slack it with sea-water, previously boiled to the saturated state, or to the state of brine, to the consistency of soapers' waste. This quantity is sufficient for an acre of land, and may either be thrown out of the carts with a shovel, over the land in the above state, or made into compost, with forty carts of moss or earth, in which state it will be found to pay fully for the additional labour, and is sufficient for an acre of fallow ground, though ever so reduced before. Its component parts are muriate and sulphate of lime, mineral alkali, in an uncombined state, also muriate and carbonate of soda. All the experiments have done well with it, but especially wheat and beans, and it has not been behind any manure, with which it has been compared. There is one instance, in which it was tried, in comparison with seventy-two cart-loads of soapers' waste and dung, and although this was an extraordinary dressing, nevertheless, that, with the new manure, was fully above the average of the field. The experiments this year are more extensive, and as far as the season has gone, look well, and promise a good crop."\* This species of manure, however, can only be prepared near the sea, or in the neighbourhood of the salt-springs in Cheshire; but as a sufficient dressing, for an acre, can be transported in four single-horse carts, it may be carried twenty or thirty miles inland to advantage.

Mr Mitchell calculates, that 3000 gallons of sea-water,

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\* Aiton's Ayrshire, p. 385.

boiled down to about 600 gallons, will slack 64 bushels of lime-shells, a quantity sufficient for two acres. The expence of carrying the water from the sea, the evaporation and slackening, will cost 20 s.; the 64 bushels of lime-shells cost him 40 s., or L. 3 in all; hence the total price of this manure, is only at the rate of 30 s. *per* acre, and the expence of carriage must be trifling, owing to the smallness of the bulk. The price, however, must depend upon the strength of the sea-water, the price of the coals, and of the lime-shells. In situations where the sea-water is strong, double the quantity of lime, slackened at the sea-side, would answer the purpose equally well, and it is in the power of every one to make it. Indeed brine might be prepared, by making pits in the neighbourhood of the sea, where the soil is retentive, or reservoirs in the rocks, and filling them in the summer months with sea-water; the heat of the sun would soon make the water of the strength required, at very little expence. Mr Mitchell has also made some experiments with urine and lime, which he has found a good manure. He gets the urine at the barracks at Ayr in considerable quantities. He has likewise used as much lime as dried up the whole night-soil, in cleaning the privies at the barracks, and found it not only useful as a manure, but that it prevented a nuisance which formerly used to annoy much both the town of Ayr and the garrison. The lime made the contents of the privy so easy to work, that the price of the night-soil and ashes, which formerly used to sell for L. 6, now fetches L. 40. The persons who have the sale of barrack-dung, ought to be compelled to mix the night-soil with lime, all over the kingdom.

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SECT. III.—*Of Ploughing, and the most advantageous Modes of conducting that Operation.*

THE swing-plough, now commonly used in Scotland, as improved by James Small, from the simplicity and the excellence of its construction, is perhaps the most useful instrument ever invented. It is cheap, is applicable to all soils and situations, can be worked by two horses or two oxen, without a driver, and is calculated either for deep or shallow ploughing, as the case may demand. It requires more skill in the management than wheeled ploughs, which the farmer may set to any particular depth, and which the ploughman cannot vary from at pleasure; but the dexterity which the Scotch ploughmen attain by practice, cannot be surpassed, and such a check is therefore unnecessary. Bad ploughmen, at the same time, may certainly be met with in Scotland, as well as in other countries, but not so frequently. To this perfection, the premiums given to the best ploughmen, at annual competitions in various districts of the country, have greatly contributed.\*

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\* It is perhaps but a just tribute to the first promoters of this scheme of ploughing-matches, to make mention of them in this work. There may have previously been incidental meetings of this sort, but they seem to have been first established, under a proper system, in the county of Clackmannan, when Mr Reoch, from Long-Niddry, in East-Lothian, became occupier of the farm of Hilton, about the year 1780. Mr James Stein, distiller at Kilbagie, who farmed extensively in the same county, (and who employed the late George Meikle to erect the first threshing-

The importance of good ploughing is such, that an intelligent farmer remarks, he has often observed a difference in the crop of some ridges where he has had a bad ploughman, when compared to the rest of the field, where the operation had been judiciously performed. Indeed, if one field is ploughed only four and a half inches deep, and another nine inches, the latter becomes capable of giving room and nourishment to twice the length of roots the former can maintain, consequently becomes more productive, and can afford a higher rent. Besides, the horses of a good ploughman, suffer less from the work, than those entrusted to an awkward, and unskilful hand.

The great difficulty in ploughing is, to determine the width and depth of the furrow-slice, which must vary according to the object the farmer has in view, and the nature of the preceding and succeeding crop, &c. The following table, will give some idea of what is considered to be a proper size, in different circumstances, though it must be regulated, in almost every case, according to the nature of the soil that is to be worked.

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machine in Scotland on an improved system), together with Mr Reoch, were accidentally led to appoint a competition of ploughs upon a certain field, where judges, after a strict examination of the work, awarded small marks of distinction to the victors. Other similar meetings succeeded, and honorary medals to the best ploughman, and small pecuniary rewards for the exertions of those who were unsuccessful competitors, were distributed. In short, the example had a wonderful effect, and since, under the patronage of the Highland Society of Scotland, the same plan has been introduced into almost every county in that part of the united kingdom. The original ploughing-matches were warmly patronised by Mr Erskine of Mar, who has uniformly displayed an ardent zeal for promoting agricultural improvement of every description, much to the credit of his own character, and the benefit of the public.

TABLE OF PLOUGHING.

Nature of the Ploughing.	Width. Inches.	Depth. Inches.
First fallow furrow, - - -	10	6-8-10
Second furrow ditto, - - -	9	6-7
Third furrow, - - - -	8	5½
Fourth furrow, - - - -	7	5
Seed furrow, - - - - -	7	4
Oat crop from turnips, - - -	9	6-7
Oat crop from clover ley, - - -	9	5-6
Beans, when on one furrow, - - -	9	6-7
Beans, if with a second furrow, - - -	9	5
Barley, first furrow, - - -	9	6
Barley, second furrow, - - -	8	5
Barley, last furrow, - - -	8	4
Potatoes, first furrow, - - -	9	4-6
Potatoes, second furrow, - - -	8	5

The depth of ploughing, as already observed, must in a great measure, be regulated by the soil there is to work upon. On thin soils, more especially on a rocky substratum, the ploughing must necessarily be shallow; but where the soil is of a depth sufficient, it is material to plough deep at the commencement of a rotation, and afterwards to vary the depth, according to the different crops intended to be raised. If summer-fallows are not ploughed deep enough, when they receive the first furrow, it is impracticable, in a dry season, to go to a sufficient depth afterwards, though it is desirable not to go deeper, than it is practicable to clear the soil turned up, of every description of root-weeds.

It is said, that when the soil is incumbent on sand, coarse clay, (till), or gravel, it is much better to rest content-

ed with the depth of soil you already have, than attempt to increase it, at the hazard of bringing up such unproductive substances. But such an idea is condemned by many intelligent practical farmers. It is observed by them, that though deep ploughing without manure, or frequent exposure after it is brought up, may be unprofitable, (as the sub-soil is less productive than the surface in its natural state), yet where these are properly applied, the soil, its thickness being increased, becomes more impervious to wet, and less so to drought, and of course more fertile; nor where the land is shallow, is the turning up of a little *till*, or coarse clay, to be apprehended, if the *till* is not of a poisonous quality; as by that means you deepen the soil, which, when the new earth is mixed with lime and dung, will be found a great improvement.\* Where sea-sand, abounding with shells, can be had in considerable quantities, that will be a sufficient corrector.

The following general rules regarding the depth of ploughing, have been recommended from various respectable quarters, and as the subject is of infinite importance, it cannot well be too much discussed, nor represented in too many points of view.

#### *Maxims as to deep Ploughing.*

1. The depth which land ought to be ploughed, must be regulated, 1, by the depth of soil, and, 2, by the means of improving it; when the soil is deep, whether light or clay, it ought to be ploughed as deep as a pair of horses can go,

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\* Baron Hepburn says, that though deep ploughing shall bring to the surface, a sour-looking, obdurate, pale yellow-coloured *till*, or coarse clay, I care not, *experto crede*, the manure given to the fallow mellow it sufficiently.

and at some seasons, perhaps, it might be advantageous to plough it with four horses; but where the land is thin and poor, and the means of enriching it scanty, the depth of ploughing ought to be in proportion to the quantity of manure.—2. Deep ploughing is highly advantageous upon every soil, and for all crops, except on those soils where the substratum is of an ochry sand, which soils, in fact, are scarce worthy of being cultivated, unless in situations, where much alluvial compost, or short town manure, can be procured.—3. It is a general rule, never to plough so deep as to go through the soil that was formerly manured and cultivated, excepting upon fallow, and then only when you have plenty of lime or dung to add to the new soil.—4. Against deep ploughing it is urged, that more manure is thereby required to enrich a great body of cultivated soil, than it would do to enrich a smaller quantity. But this objection is evidently more specious than solid. In fact, whilst lime sinks in the ground, putrescent manures ascend. In a burying-ground, the soil is never meliorated below the grave, whilst it is enriched to the very surface. There is no great danger, therefore, in putting dung deep. If laid on shallow, it is not only dried up, but actually volatilizes and is lost.—5. Farmers who follow the practice of deep ploughing, find a great advantage from it, both in dry and in wet seasons. The extreme of either is not so prejudicial as if the crop had been ploughed with a shallow furrow.—6. Many farmers recommend, when fallowing land, to go as deep as possible the first furrow, by which the subsequent furrows will be more easily done, and to expose the soil to the winter's frost and to the summer's heat; but when land is ploughed in spring for beans or oats, a strong soil cannot be ploughed with safety, above five or six inches, and when lime or dung has been mixed with the soil, a shallow fur-

row, not exceeding four or five inches in depth, is advisable.\*

Deep ploughing is not to be recommended: 1. According to some, when rich old leys are broken up for cropping, though many respectable farmers are decidedly of opinion, that old grass land should be ploughed with a strong furrow at first, so as the harrowing process, upon which both the crop and the condition of the ground afterwards materially depend, may be sufficiently executed. 2. When grass only two or three years old is broken up, more especially where it has been pastured with sheep; a system to be particularly attended to in ploughing land that is much infested with annual weeds, as, from the extreme condensation of the soil, by the trampling of the sheep, a furrow, even of a moderate depth *to appearance*, will make the plough penetrate, below the staple that had been cleared, by the culture given during the previous fallow; from which circumstance, myriads of the seeds of annuals are raised to the surface, where they vegetate, and materially injure the crop cultivated, besides replenishing the soil with a fresh supply of their own seeds. 3. When lime has been recently applied, as it has such a tendency to sink from its own weight, and the moisture which it imbibes. 4. Where turnips have been eaten off by sheep on the land where they grew. In all these cases, from four to five inches deep will be found sufficient. And,

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\* When Mr Wood commenced his operations on the Great Tew estate, in Oxfordshire, he began with a deep ploughing, though the farmers in the neighbourhood assured him, that it would spoil the staple of the lands; but when they saw 54 Winchester bushels of oats, and other crops in proportion, *per acre*, their ideas were soon altered, and the valuator of the crops said, "That they must now all try to spoil the staple of the land to get good crops." Their ploughing had formerly been so shallow, that it hardly covered the dung, which they considered an advantage.

5. If land is infested with grass, which generally runs much on the surface, the first ploughing should not be deep.

In the following cases, deep ploughing is advisable. 1. Where the first furrow is given to land intended to be fallowed in the end of autumn or beginning of winter, and where grass or root-weeds do not abound, the soil is thus pulverized and sweetened by the frost; and, 2. In muirish or cold soils, as it affords a greater scope for the roots of plants to procure nourishment, admits the superabundant moisture to subside from their roots, and prevents the summer drought from making an injurious impression on the growing crops: for it may be remarked, that on such land, shallow ploughing exposes vegetation to be starved or drowned in wet weather, and to be scorched or withered in dry.

The advantages of deep ploughing, a practice which cannot be too frequently recommended, shall next be described. Some of my correspondents complain, that it is likely to get into disuse with slovenly farmers, and to be too much neglected by many who, in other respects, merit a different character. To prevent the introduction of so injurious a system as shallow ploughing, it would be advisable, in some cases, to have one or two strong ploughs, calculated even for four horses, by which the strongest and stiffest land may be cultivated to the proper depth, whenever it was necessary.

#### *Advantages of deep Ploughing.*

1. Bringing up of new mould is peculiarly favourable to clover, turnips, beans, and potatoes; and indeed, without that advantage, these crops must diminish in quantity, quality, and value. 2. Deep ploughing is of infinite consequence, not only by furnishing more pasture to the roots

of the plants, but, above all, by preventing the injurious consequences of either too wet or too dry a season. This is a most important consideration, as, if the season is wet, there is a greater depth of soil for absorbing the moisture, so that the plants are not likely to have their roots immersed in water; and in a dry season, it is still more useful, for in the lower part of the cultivated soil, there is a reservoir of moisture, which is brought up to the roots of the plants by the evaporation which the heat of the sun occasions. 3. By deep ploughing, also, the ground may be more effectually cleared of roots and weeds of every description: at the same time, where they abound, it is a good rule, not to bury them by the first ploughing, otherwise it becomes difficult afterwards to clean the land: But after the land is cleaned by hand-picking, and by the instruments employed for that purpose, it is then proper to raise fresh mould, to incorporate with the manure to be afterwards applied. By deep ploughing, animal and vegetable manures may be covered, which is not the case with shallow ploughing, in consequence of which, much of the value of such manures is lost.\* 5. An intelligent farmer, after pointing out that deep ploughing increases the staple of the soil, keeps the roots of the corn from being injured by wetness, and also enables the crop longer to resist drought, adds,—“*I have ever found deep ploughing attended with good crops, when ridges, shallow ploughed, in the same field, were but indifferent,—a decisive proof in favour of deep ploughing.*”†

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\* It is hardly possible to bury animal manures, every atom of it rises to the surface; but fossil manures have a tendency to sink.

† The Norfolk farmers, generally possessing a thin light soil, with a poor and barren subsoil, prefer shallow ploughing at all times, and argue, that it is easier to keep a small quantity of soil in good heart, than a greater quantity, which would be formed by deep ploughing, and also

It is another important advantage resulting from deep ploughing, that it has a material effect in improving the climate of any district, where too much moisture may abound, which would be retained by the imperviousness of

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that it is easier to keep it clean of root-weeds; nay, some imagine that the *pan*, as it is called, retains moisture, though it is evident that a thin soil must soon have all the moisture in it much more speedily evaporated than a deep one. Mr Church has heard the farmers in that county say, that the land was always injured when the *pan*, or top of the subsoil, was broken by deep ploughing, which was never done but by a careless or bad ploughman. There may be some ground for their partiality in favour of their mode of ploughing thin and light soils; and it would not be advisable for them to alter their system, unless they fallowed their lands, gradually deepened them, and limed and dunged the new soil. But if on these principles they were to increase the depth and quantity of the surface soil, their crops would be more certain and abundant, more especially in dry seasons. The following valuable hints on this subject, are drawn up by one of the most intelligent farmers in Scotland, whose name, if he had permitted me to use it, would have done credit to any publication.

“After shallow ploughing, the crop, in heavy rains, is very apt to be soaked about the roots, in consequence of which the straw is whitened prematurely, and the grain does not come to perfection; hence the necessity, when the surface is thin, of thickening it by deep ploughing. I have seen deep ploughing this kind of land, for the first, and even the second year, after ploughing up the under-soil, produce a teasing crop of thistles, which was hurtful to the corn crop; but after the cold soil is well mixed with the old surface-soil, and after the lime and dung applied to it, *when summer-fallowed*, has begun to operate on the new soil, I have found great benefit from this operation; but it is the winter-furrow before the summer-fallow that should be ploughed deep; the lime and dung applied to the fallow, as I have already mentioned, operate strongly on the fresh soil. I would recommend ploughing even light lands, although thin, to a proper depth, though gravel or stones may be turned up and mixed with the surface-soil. I have found no inconveniency by it. Both turnips and corn crops, as well as pasture grass, stand out better, both in wet and dry seasons, when a shallow surface-soil is deepened, even by

the soil. Of this fact there is most satisfactory evidence. Dr Moir of Leckie, in Stirlingshire, had an estate of about 1000 Scotch acres, in the Carses, or lower parts of that county, which had been ploughed to the depth of only two inches or two and a half. That small portion of the soil had, accordingly, by continued cultivation, become much pulverized; whilst the adjacent stratum had, on the other hand, become hardened and compacted by the same process, so as to become totally impervious to water. The water consequently stagnated between the soil that was held in cultivation, and that which lay immediately beneath it, as if the latter had been clay or rock. He was accidentally led to try the effect of a double depth, and drains were at the same time constructed, to carry off the superfluous moisture. By these means, the ground has been rendered dry and fertile. The water, which was formerly lodged two and a half inches below the surface, now finds room to diffuse itself, and any superfluous quantity is carried off by proper drains. The result also has been, that since this improved mode of cultivation has been introduced, intermittent fevers, which were formerly

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an under stratum that may appear very worthless. As a proof of the utility of deepening surface-soils, both wet and dry bottoms, look at the patches of gardens that have received deep digging, or shallow trenching, belonging to the cottages placed on the skirts of the muirs all over Scotland, and you will observe the additional verdure and luxuriance of crop upon these patches, more than upon the lands adjoining, the surface of which is often very little more than scratched by the plough, and the dung and other manure applied to it has no deepness of soil to operate upon, so as to produce a good crop."—It is to be observed, however, that the quantity of dung usually applied to patches of garden ground, so far exceeds what any farmer can afford to give his corn fields, particularly in a muirland district, that the comparison here adduced, cannot, in that respect, be relied on.

epidemic in these Carse, are now altogether unknown in that neighbourhood.\*

But although deep ploughing, to a certain extent, is advisable, yet there is a medium in this as well as in other things. Mr Hope of Fenton, in East Lothian, states, that he has tried the experiment of ploughing very deep with four horses, the result of which was far from encouraging a continuance of the practice. In one case, where he ploughed part of a fallow field with four horses, at fourteen inches deep, the crop of wheat was evidently worse than upon the rest of the field, that was ploughed in the usual manner; the land at the same time was of good quality, sufficient to have admitted a furrow much deeper than what was given. The reason of the inferiority of the crop, upon the deep-ploughed part, appeared to be, in consequence of that part of the soil, which had for ages been regularly manured, being turned down below the reach of the roots of the plants, and soil of a poorer quality brought up in its place. He is therefore inclined to think, that it is unnecessary to plough deeper, than where there is a fair probability of the different kinds of plants sending their roots; and as beans, clover, and turnips, the only tap-rooted kinds usually cultivated in this country, seldom send their shoots above seven or eight inches down into the soil, and the culmiferous species not so far, it is probable, from these circumstances, that from seven to nine inches, may be deep enough, for all the purposes of ordinary culture. Occasionally, however, ploughing even a little deeper, in

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\* See Dr Graham's valuable Report of Stirlingshire, p. 246 and 247. More cleanliness, and better living among the lower orders, have also contributed to the great diminution which has taken place in fevers of an intermittent sort.

the course of a rotation, for the reasons formerly assigned, is advisable.

The following points remain to be touched upon, regarding ploughing: 1. The angle at which the furrow-slice should be laid in particular cases; 2. The proper time for ploughing wet and dry soils; 3. The advantages of water-furrowing; and, 4. The rate of ploughing with a pair of horses.

1. As one principal object in ploughing is, to lay the land so that the harrows may, in the most effectual manner, raise mould to cover the seed, this object is most effectually accomplished, by ploughing land of every description, with a furrow-slice about seven inches deep, and which, if about ten inches and a half broad, raises the furrow-slice with a proper shoulder; thus endeavouring to form, by the shoulder of each furrow, the angle 45, the point which ought to be referred to, when determining between the merits of different specimens of ploughing. That is best obtained, by allowing the plough to incline a little upon the left side, and making the breadth of the furrow always bear a due proportion to its depth, which is about two-thirds, or as six deep and nine broad.\*

2. In regard to the proper time for ploughing either light or clay soils, it is a good maxim, that light land should be ploughed when it is in a moist state, but clays in a medium state, neither wet nor dry. When perfectly dry, they

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\* Remarks by Mr Hope of Fenton. This is the general, if not the universal opinion of the Scotch farmers. In Norfolk they think that the soil should be completely reversed, without a shoulder, and perfectly flat. The angle 45 is strongly recommended in Bailey's Essay on the Construction of the Plough, and in his Durham Report; and in Brown of Markle's Treatise on Rural Affairs.

will not plough at all, being so hard and tenacious, and they ought not to be ploughed when wet, as the land would be ruined by poaching. This circumstance renders the cultivation of clayey soils so extremely difficult. Mr Joseph Burns of East Craig, has found from actual experience, that when land can be ploughed dry in autumn, harrowed and water-furrowed, (after cross-harrowing), that land will always be in a state sufficiently dry for ploughing in the spring, or perhaps for sowing, without spring-ploughing at all, but merely scarifying.

3. In preparing land for a crop, water-furrowing is a very important operation, more especially in wet soils and climates; indeed, not only are these water-furrows, or surface-drains, made and dressed by the plough, but a *spade-man* is also employed, in all the well-cultivated districts of Scotland, to clear them out, as soon as the ridge is ploughed: the land is thus never injured by surface-water.\*

4. Mr Blackie of Holydean has sent me the following statement of the number of miles his ploughs travel in a day. An English acre of land, he observes, is ten chains long, and one broad; one chain is 66 feet: divide that into 80 furrows, which is as narrow as any body ploughs,—the whole furrows, in one acre, measure no more than 10 miles.† An acre in one day, is very good work for two

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\* Hints from Mr Peter Jack of Moncur. This plan is very strongly inculcated, and minutely described, in the Berwickshire Report.

† Mr John Shirreff remarks, that the distance travelled by the horses ploughing an English statute acre, with 80 furrow-slices to the chain of 66 feet, is certainly ten miles, exclusive of turnings. But there are 88 furrow-slices, nine inches wide each, in 66 feet; so that the horses ploughing a furrow-slice of that width, travel 11 miles in ploughing a

horses, yet is a very slow pace when divided into eight hours' work. Turning at the ends of the land takes up one-tenth of the time. In a dry fine soil, and on level ground, a pair of good horses will plough twelve chains; on wet heavy land, nine, sometimes not more than eight chains; in crossing or stirring turnip land in summer or spring, they will do sixteen chains, and in some very fine free land, two acres. It must be remarked, however, that much depends, on the nature of the soil cultivated, and the season of the year in which the work is performed.

Mr Erskine of Mar, who has paid much successful attention to many branches of husbandry, calculates, that the number of yards travelled in ploughing an acre and a half with a 16 inch furrow-slice, is - 16,320 yds. And with a furrow-slice of 18 inches, - 14,400 The furrow-slice of 8 inches, - - 32,640  
 ----- 9 ----- - - 29,040

To the same intelligent correspondent, I am also indebted for the following tables :

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statute acre, exclusive of turnings. And, admitting the turnings to be one-tenth, the horses actually travel 12 miles and 176 yards, in ploughing a statute English acre.

Tables, shewing the Quantity of Ground ploughed, according to the different Breadths of the Furrow-slices, and the Rates of the Horses walking.

Breadth of the Furrow-slice.		Rate per Hour.		Length of Way travelled in ploughing.		Quantity of Ground ploughed.			
Inches.	Miles. Furlongs.	Yards.	Roods.	Poles.	Inches.	Miles. Furlongs.	Yards.	Roods.	Poles.
8	1 —	14,144	2	24	8	2 —	28,168	5	7
9	—	14,157	2	37	9	—	28,193	5	33
10	—	14,148	3	11	10	—	28,188	6	21
11	—	14,157	3	22	11	—	28,215	7	5
The Rate of walking, being one Mile and half a Furlong.					The Rate of walking, being three Miles.				
8	1 $\frac{1}{2}$	14,960	2	30	8	3 —	42,296	7	31
9	—	15,004	3	4	9	—	42,350	1	30
10	—	15,012	3	19	10	—	42,336	9	32
11	—	15,048	3	32	11	—	42,273	10	27
The Rate of walking, being one Mile four Furlongs.					The Rate of walking, being four Miles.				
8	1 $\frac{4}{5}$	21,216	3	36	8	4 —	56,336	10	14
9	—	21,120	4	14	9	—	56,386	11	26
10	—	21,168	4	35	10	—	56,376	13	2
11	—	21,186	5	14	11	—	56,430	14	10*

\* It is supposed that in England, in general, the common breadth of the furrow-slice is about nine inches; but the generality of the farmers

The effect of short ridges, and consequently of frequent turnings, is most strikingly exemplified, in the following table, drawn up by Mr Erskine of Mar, from actual experiment :

Names of Fields.	Length of Ridges.	Breadth to give an Acre.	Breadth of the Furrow-slice.	Number of Furrows in the Acre.	Time it takes in turning.	Time taken up in stirring the Soil.	Number of Hours in the Day's Work.
	Yards.	Feet.	Inches.		H. M.	H. M.	H. M.
7. South Gubber,	78	186	8	279	4 39	3 21	8
3. East Loch,	149	98		147	2 27	5 33	8
11. Harperhill,	200	73		109	1 49	6 11	8
2. South Muir,	212	69		103	1 43	6 17	8
17. Long Bog Croft,	274	53		79	1 19	6 41	8

Thus it appears, when ridges are 78 yards in length, that no less a space of time than four hours and thirty-nine minutes is spent in turnings, in a journey of eight hours; whereas, when ridges are 274 yards long, one hour nineteen minutes is sufficient, in the same length of time. What

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in Norfolk, for various reasons, prefer having their furrow-slices full eleven inches broad; so that the quantity of the ground stirred, in the same number of hours, worked by them, must be considerably more than farmers in other districts can do, where the nature of the soil requires to have the furrow-slice of a narrower breadth. I understand that it is the practice in Norfolk, to allow four horses for each plough, two for a journey of five hours in the forenoon, and two others for five hours in the afternoon. This must greatly increase the expence of cultivation.

then must not the waste of time be in small paddocks, and when four or perhaps five horses are yoked one after the other?

It may be proper also to observe, that some farmers, convinced of the advantages of frequent ploughing, keep an extra stock for that purpose. Mr Andrew of Tillilumb states, that he constantly keeps four pair of work-horses, and generally, in spring and autumn, has been in the custom of making up a fifth pair for harrowing, by yoking a saddle-horse and young colt.\* This is rather more than is usually kept on farms of such an extent, (112 Scotch, or 142 English acres), but he has an advantage by it, being thus enabled to dress his land more completely; and the frequent ploughings, he finds, effectually prevent the depredations of the slug-snail.

Here it may not be improper to take notice of a system long practised in East Lothian, that of spring-sowing, without spring-ploughing, and which Lord Kames, in his *Gentleman Farmer*, first printed *anno* 1776, has strongly recommended.\* Mr Wight of Ormiston, for twenty-five years past, has been in the practice of sowing barley and oats upon the winter-furrow, and with much advantage, the crops being always more certain and more abundant.

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\* "The preferable method for sowing oats, and especially in a clay soil, is to turn the field over after harvest, and to lay it open to the influences of frost and air, which lessens the tenacity of clay, and reduces it to a fine mould. The surface-soil by this means is finely mellowed for the reception of the seed; *which it would be a pity to bury by a second ploughing before sowing.* We are taught by experience, that this soil, ploughed before winter, is sooner dry than when the ploughing is delayed till spring; and as early sowing is a great advantage, any objection on account of the superficial crusting, is easily removed by a strong harrow, which would produce abundance of mould for covering the seed." *Kames's Gentleman Farmer*, p. 95 and 96.

Independent of the increase of spring labour, by ploughing lands sufficiently clean and prepared before the winter, it is a dangerous and precarious operation turning up clay soils in the spring, more especially for barley, besides burying and losing the advantage of a fine mellow surface, which cannot be regained after a spring-ploughing. There is also the risk of rain during the operation, which in many instances sours the land so completely, as to render the chance of a crop very precarious. Mr Fletcher of Balinshaw, in Forfarshire, was accustomed to sow barley on a winter-furrow, above twenty years ago. A respectable farmer in the Mearns observes, that if too great an accumulation of work was likely to be apprehended in the early summer months, an additional ploughing might be saved, by sowing oats on the winter-furrow; and another intelligent farmer near Dalkeith, (Mr Mylne of Smeaton), remarks, *that ploughing for barley in spring is unnecessary,\* unless in a very bad season, when the land could not be wrought, as it should have been, before winter.* Mr Yeaman of Murie, near Dundee, also tried barley on a winter furrow; and it was observed, on the crowns of the ridges, and as low down as the middle, between that and the furrows on each side, the barley was more luxuriant, and appeared richer, than that sown in the common way; but towards the furrows, probably owing to the ridges being too much gathered, it was thinner and shorter; so that on the whole the difference of produce would not be material. A ploughing, however, was saved. Mr Stewart of Hillside states, that in his neighbourhood a second furrow is not given for oats, however early in the winter the land

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\* It is said, that without ploughing in the spring, the weeds would soon be master; but that might be prevented by the use of the scuffler.

has been ploughed; nor is there any difficulty observed on that account: and Mr Thomson of Bewlie, in Roxburghshire, observes, that it is a common practice in that part of the country, to sow oats after both the winter and spring furrows. From his own experience, he certainly prefers the winter-furrow for oats, particularly when a dry spring and summer takes place. Old ploughed land keeps in the sap, and brings forward the young plants equally; whereas the corn sown in the spring-furrow, in a dry season, does not come half away at first, and is full of aftershoots; hence does not produce nearly so good a crop as the winter-ploughed lands. It must be remarked, however, that a great part of the ground which carried turnips, must in every year be ploughed in the spring months; also, that in all backward seasons, much of the grass land intended for oats, cannot be got ploughed sooner than February or March.

On a point of such importance, it is proper to state the arguments on both sides, leaving the question to be ultimately decided by future experiments. The farmers in the Carse of Gowrie do not think it would answer their strong soil. When they have spare time in the beginning of winter, to plough part of their clover leys before Christmas, (which is sometimes the case), they think the mould or soil is too close, and on that account the oats are a more stunted crop, than when the ley is ploughed in January or February; and Mr Dudgeon, Prora, maintains, that clover ley ploughed soon in February, upon soft land, and upon all deep light loam for oats, will generally produce from one to two bolls *per* acre more, than if it had been ploughed about Christmas or early in January.\* The early-plough-

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\* Mr Dudgeon likewise remarks, that when clover ley is ploughed for wheat, if any rye-grass has been sown with the clover, it ought never to

ed land, is also more apt to carry couch-grass among the oats.\* Mr Paterson of Castle-Huntly is decidedly of the same opinion. He admits, that barley might be sown on the winter-furrow, where the soil is loamy, with a better chance of success, for that particular crop; but he contends, that repeated ploughings both in clay and loam, during the driest season of the year, before the barley seed-time, is so necessary for perfectly cleaning the land,† that no saving of labour could compensate the want of them, which saving of labour *is supposed to be the best, if not the only reason, that can be given, for sowing barley on a winter-furrow.* As to the absurdity of burying that part of the surface after being prepared and meliorated by the influence of a winter atmosphere, and bringing up a soil less prepared, he asks, may not this be rather more speculative than solid?‡ He

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be harrowed across, but always along the ridges, to prevent the rye-grass getting up between the furrow-slices.

\* Remarks by Mr Jack of Moncur. This is a great argument against too early ploughing for oats, as it sets the couch-grass roots in motion, and greatly increases their quantity in the soil; thereby both injuring the immediate crop, and adding greatly to the trouble and expence of the subsequent fallow.

† On this subject, Mr John Shirreff remarks, that the ground on which barley is to be sown, is always supposed cleaned *previously* by summer-fallow, by turnips, potatoes, or some other cleaning crop, and never to depend on cleaning to be administered that very spring on which the barley or other grain crop is to be sown. So far from destroying, annual weeds at least, spring-ploughing promotes their vegetation and increase.

‡ Mr Wight of Ormiston cannot concur with Mr Paterson in the idea, that burying the surface, prepared and meliorated by the influence of a winter atmosphere, and bringing up a soil less prepared, is more speculative than solid. The soils can never be more softened, or rendered more capable of receiving the seeds, than after a winter's frost; and he has always observed, that the seeds were abundantly covered, and enabled to

is much inclined to think, that it would be much better to give the land another ploughing, as it would mix and soften the soils, render them more capable of receiving and covering the seeds, and enable them to spread their roots to greater advantage, by which a more certain crop would be insured. Upon the whole, he is clearly of opinion, that it would be impossible to keep the ground clean, and in such good order for a succession of crops, without sowing barley, or something of the same kind, after having gone through all these operations.

On the other hand, it is contended by a number of intelligent English farmers, that spring crops may be successfully sown without spring-ploughing: That the land can be effectually cleaned from root-weeds by a couch-rake, and may be sufficiently stirred and pulverized by the cultivator or scuffler: That it is of infinite consequence to expose strong clay soils to the winter frosts, (which can only be done by early ploughing), but that the benefit of that practice is lost, if that part of the soil is ploughed down, that has been meliorated by the frost and the atmosphere. Can any thing, it is said, be more absurd, than to bury that dry friable porous surface, which the frosts have left in so favourable a state, and upon which, if rain falls, no plastering ensues, as it dries speedily, and remains in a porous state; whereas, if ploughed in spring, any rain that falls, so impregnates the soil with moisture, that if worked, it plasters, and the north-east winds harden it like stone. It may be observed at the same time, that many intelligent practical farmers in Scotland, consider a spring-ploughing necessary, when

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spread their roots to sufficient advantage, so much so, that the barleys are in general rather too luxuriant than otherwise. He agrees, however, with Mr Paterson, that it is too early to plough clover leys before Christmas, and that ploughing them in January or February will insure a better crop, and a cleaner one.

beans are drilled, and that a ploughing ought likewise to be given to the fields which carried turnips. Except for beans or barley, there is no necessity, they admit, for ploughing in the spring months; in regard to oats, which are so frequently sown after grass, a second ploughing is never thought of.

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#### SECT. IV.—*On Fallowing.*

SUMMER fallowing of land, or the practice of working it during the summer months, has undoubtedly been the chief source of improvement in the clay soils of Scotland; for the ground in cultivation, having been kept in constant tillage for ages, was infested with weeds of various descriptions, which by no other means could have been kept down or eradicated. In dry soils, since the introduction of the turnip husbandry, fallowing is no longer necessary;\* though in

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\* Mr Brown of Cononsyth in Angus, however, contends for fallows even on dry soils. He states, in a communication to the author, that one-seventh of the dry land of his farm is in fallow or turnips, but in general he only sows about ten acres of it in turnips, as he finds that he has much better grass, when sown among wheat after fallow, than with oats after turnips; and when broke up from ley, the difference of the oat crop, in favour of bare fallow, is also discernible. A crop of wheat, he maintains, is obtained at less expence than turnips and oats, and on an average of years, is as valuable; the manure produced by wheat straw, may not be so rich as when many turnips are raised, but a greater quantity is procured, and if driven out into a large dunghill in the winter months, will answer perfectly well for fallows. Probably sheep are not much fed with turnips in that neighbourhood, for it is the basis of good husbandry, on light soils, to have turnips eaten with sheep, to tread

strong lands, it is still accounted the foundation of their fertility, by the most intelligent practical farmers that Scotland can boast of. Indeed, the peculiar correctness and attention, with which the fallowing process, in strong soils, is executed in Scotland, is considered to be one of the most important and distinguishing features of the Scotch system. It is not repeated so frequently as it is in many districts in England, occurring in general but once in the course of six years; the soil of the field subjected to this operation, however, by frequent ploughings, though consisting of the strongest and most stubborn clay, is thus completely pulverized, weeds are extirpated, insects are destroyed, and fertility insured during the whole course.

In considering this subject, it is proposed to give, 1. An account of the manner in which the fallowing process is performed; 2. The expences attending it; 3. A statement of the advantages derived from the practice, as transmitted to me by a number of the most intelligent practical farmers in Scotland; 4. An account of some cases where fallowing strong lands is not adopted in Scotland; and, 5. Some miscellaneous particulars connected with this branch of the enquiry.

1. *Of the manner in which fallowing is performed.*—As the farmers of Scotland are convinced, that their after-crops are good, in proportion to the correctness with which the summer-fallowing process is executed, the greatest possible attention is bestowed on that operation. The first ploughing, if the season will admit of it, is given, as soon as the sowing of the winter wheat is finished. Mr Brown of Markle recommends, that this should be done by gathering

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them thoroughly, without which neither wheat nor clover can well be expected.

up the ridge, which both lays the ground dry, and rips up the furrows. The second ploughing is given as early as possible after seed-time, when the ridge should be cloven down, by a strong furrow, preparatory to cross-ploughing, which is a most essential part of the process, and one that ought to be carefully and substantially executed. About the end of June, the land should be so completely reduced by harrowing and rolling, as may permit couch-grass and other root weeds to be gathered by the hand. It should then be ridged up, when, if sufficiently cleaned, dung may be applied; but if not in that state, another ploughing must be given, previous to the application of manure, after which it ought to be seed-furrowed, by the end of August, and of course be ready for sowing any time after the middle of September. It has been found, that by allowing land to lie for several weeks between seed-furrowing and sowing, it gets consolidated before the roots of the plant strike in the ground, in which way the plants are not so apt to be thrown out of the soil by the spring frosts.\*

The process of fallowing, therefore, according to the Scotch system, is both laborious and expensive, but it is the pivot on which depends the proper cultivation of clay lands in Scotland. The number of ploughings, (including one or more cross-ploughings), where the soil is stubborn, must be as many as from six to seven. Rolling repeatedly is also necessary to break the clods, in order that access may be had to the root-weeds mixed with the soil, and the land must be harrowed for the purpose of bringing those weeds to the surface. There is reason however to believe, after every solid clod has been crushed and reduced by the roller, that this object may be attained by the scuffler, when the

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\* Communication from Mr Hope of Fenton. Consequently a stale furrow is considered to be essential.

irons are bent. After harrowing, it is a most essential part of the process, to collect the weeds by hand-picking, the expence attending which is well bestowed. Mr Brown justly observes, that more root-weeds are taken off by one gathering, than can be destroyed by a couple of ploughings, allowing the season to be ever so favourable; and if hand-gathering will save one single ploughing, (which cannot be stated at less than 12s.), the expence is amply repaid. Some burn the roots that are gathered upon the field, and spread the ashes, whilst others accumulate them into a heap; frequently turning it over, till the weeds rot, and by mixing the whole with lime, a most excellent compost is made, and an enemy is converted into a friend.\*

2. *Of the expence attending the process.*—Nothing but the deepest conviction of the advantages to be derived from that operation, could induce such multitudes of skilful and intelligent farmers, to incur the numerous and heavy charges attendant upon the summer-fallowing process. It is evident, however; that the expence must depend upon the amount of the rent, the number of ploughings, &c. and the value of manure applied. Indeed, the crop of wheat succeeding the fallow, must pay the rent and expences of two years; of the amount of which, the following calculation will give some idea.

	Per Scotch acre.	Per English acre.
1. Six ploughings, harrowings, &c. - - -	L.4 0 0	L.3 3 0
2. For the rent of two years at L.3 <i>per annum per</i> Scotch, or L.2 : 7 : 3 <i>per</i> English acre.	6 0 0	4 14 6
Total,	L.10 0 0	L.7 17 6

† See Brown's Treatise on Rural Affairs, vol. i, p. 202.

Mr Somner of Gilchriston, however, estimates, that *including lime* as well as rent and labour, the expence cannot be less than L.15 *per* Scotch, or L.11, 16s. *per* English acre. Nay, L.20 and upwards have in many cases been so expended; but the whole of that sum cannot be charged against the fallow crop, as the lime remains productive for many years afterwards.

3. *Advantages of fallowing clay soils.*—Nothing could justify such an expence but advantages of a superior description; and the returns which I have received in favour of the fallowing system, are so extremely important and satisfactory, that though it may appear tiresome to some readers, I think it incumbent upon me to give extracts from a number of most interesting communications which I have received, explaining the advantages of the system.

1. These benefits are very ably stated by one of the first farmers in East-Lothian, (Mr Hunter of Tynfield). That gentleman observes, that he has always experienced, a naked fallow necessary, once during a rotation of six, (1. Fallow; 2. Wheat; 3. Clover; 4. Oats; 5. Beans; 6. Wheat); and he is persuaded, that it will be found the case, in every soil not of the turnip sort. Clay soils become hard when constantly cropped, by being always ploughed in winter, or early in spring, and as in so moist a climate as that of Scotland, they must be often wet during the operation of ploughing and harrowing, they lose their fertility, becoming as it were impervious to the sun and air, as well as to the roots of plants, &c. Summer-ploughing is necessary to rectify this; besides giving opportunity to take out all sorts of root-weeds, to put in lime, &c. &c. Other drilled crops, as beans, peas, or tares, must be sown early in spring. Potatoes also must be planted in April to have a full crop, and cannot be substituted for a fallow to any tolerable extent; even

the ruta бага seems to Mr Hunter unfit for the purpose in our northern situations, as it is long of coming to its growth, and ought to be sown early in May, otherwise it will seldom be a full crop. The grand object with the skilful agriculturist will be, to keep his land clear of weeds of all sorts, and summer-fallow has ever been found the only sure method of doing so. Hitherto no plant has been found so well fitted to permit that as the field turnip, which may be drilled, with the best prospect of success, from the first week of June, to the second week of July inclusive, giving full time to clean and prepare the land properly, which, together with the ploughings in the rows among the turnips, completes the fallow in the most perfect manner. This, however, is only applicable to soils of a light description.

In the Carse of Gowrie also, fallowing is considered to be indispensable. That operation, it is said, is necessary to meliorate the ground, to make it of a kindly texture, to clean it of weeds, &c. It likewise gives an opportunity to repair all the small drains in the field; enables the manure to be applied at a proper time, and the land to be sown at a favourable season; by which means, the successive crops are greatly encouraged, (the ground being in complete order to yield its produce), and less dung answers the same purpose for a succession of crops.\* A most respectable correspondent assures me, that one-fourth less dung may be used to a fallow field, than to one in a constant course of cropping, and that the effects will be more discernible in the first than in the latter case. The crop of wheat is also more abundant, by at least two bolls *per* Scotch acre, after a fallow, than after beans.

Mr George Robertson remarks, that in other countries,

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\* Communication from Mr Drummond of Westbank.

fallows often take place once every three or four years, but that in such cases the land is so imperfectly worked, that the process has an equal tendency to promote the growth of weeds, as to destroy them. The Scotch husbandman, on the other hand, is more energetic, for he cultivates his fallows thoroughly, with five or six or seven ploughings, and thus converts the soil of a field into the soil of a garden. This insures fertility throughout a whole rotation of six years, with a certainty not otherwise attainable.

Another correspondent maintains, that naked fallows upon a strong clay, incumbent upon a retentive bottom, can alone enable the farmer to pay a high rent. And he contends, that upon strong stubborn clays, *newly brought into culture*, it is for the interest of the farmer to fallow every *fourth year*, instead of every sixth. Deep ploughing, naked fallow, lime, and every other species of manure that can be procured, are indeed the groundwork of that system, which enables our farmers to pay such high rents, with an inferior soil and a precarious climate. As a proof of the advantages of fallows *on clay soils*, he refers to the inferior produce of land in the Carse of Gowrie and Falkirk, before the introduction of summer-fallow; and to the present state of clay land in the neighbourhood of Edinburgh, where the great command of manure induces the farmers to follow the system of constant cropping, though on farms but a few miles distant from their own, better crops are raised, upon the same description of soil, without the aid of the *dung of Edinburgh*, but with a fallow.

Mr Rennie of Kinblethmont is decidedly of opinion, that fallow upon wet-bottomed land is quite indispensable every sixth year, and that any attempt to get quit of that useful and necessary operation, upon strong clay soils, must always be attended with ruinous consequences. The only effectual substitute for fallow is turnips, but that crop can-

not be introduced upon soils such as above described, and wherever turnips cannot be grown to advantage, fallows are absolutely necessary.

Mr Brown of Cononsyth states, that, considering the short period of dry weather which is to be found in spring, even on the eastern parts of Scotland, the foulness contracted by many fields, in spite of the exertions of the most active farmer, and the difficulty of rendering them clean, even by a whole summer's work, any expectations of success, in clearing the land during the spring alone, and thereby abolishing summer-fallows, cannot be well founded; and, although summer-fallow may possibly be removed to a greater distance, yet he is convinced that the process is of such importance to agriculture, that it must be continued.

Mr Spears of Dysart is also decidedly of opinion, that on strong soils, no management will turn out so advantageous, as having always about one-sixth of the farm under summer-fallow. A heavy strong soil, he is convinced, cannot be kept clean and in good order, without this system, and to this he has paid particular attention, both in his own practice, and in that of others. A farmer cannot depend on getting his strong soil sufficiently cleaned throughout the summer, under green crops, so as to ensure a full crop of wheat; whereas, under a properly managed summer-fallow, it hardly ever fails of producing a large crop, of the best quality, and, on an average, at least 13 bushels *per* Scotch, or about 10 bushels *per* English acre more, than when after any crop, with this great additional advantage also, that of requiring little more than one-half the manure that must have been used in raising wheat on any other system, and also having a greater bulk of straw for being again converted into manure. Besides, the land is left in infinitely superior condition, and which will show itself for several successive crops; the beans also, or other green

crop after the fallow wheat, will be easily cleaned, and if the soil be good, the beans or green crop may be followed with another crop of wheat, at least in part. On a dry loamy soil, a great deal, no doubt, may be done without summer-fallow, by preparing for the wheat crop with beans, potatoes, turnips, &c.; because on this soil, you can, in general, depend on having these crops sufficiently cleaned, and taken from the ground in a proper time for sowing wheat, though in such cases, much must depend upon the season. Mr Spears long ago endeavoured to do away the necessity of fallow, by sowing the whole of his wheat after beans and other green crops; but as his farm consisted of a heavy loam mixed with clay, and upon a retentive bottom, he could neither depend on getting his wheat sown in proper time, nor the land kept in good order. In fact, had he persevered in that system, notwithstanding a great command of manure from his distilleries, he should have failed in raising the quantity of wheat for which his farm was adapted, whilst the soil would have gone quite foul, in spite of every exertion to prevent it, which is uniformly said to be the case, in every instance, where the process of summer-fallowing, on clay soils, has been neglected.

Mr Rennie of Oxwell Mains, observes, that it is next to impossible to clean land so well with green crops, but that there may remain a great many root-weeds, so very prejudicial to the soil. The proper time for doing this effectually, is in July or August, and it must be accompanied with deep ploughing, which can never be performed if the land is under a crop.

Another intelligent correspondent remarks, that wheat sown after fallow, stands a better chance of escaping the effects of the mildew, in consequence of the crop being brought, earlier in the season, to that state of maturity, which renders it unassailable by that destructive disease.

This will be more especially the case, if the crop is laid down without dung, as rich manuring is very apt to occasion that disease. Upon the best soils, indeed, many agriculturists refrain from dunging their fallows, reserving the manure to the year when the land is either under clover or beans, though at that time it cannot be so frugally applied.

As fallows are the surest foundation for growing wheat, and as bread-corn is the only article of which this country is in danger of being in want, it is an additional reason, why the fallowing system should be continued upon clay and heavy soils, especially as these soils can, by no management, be fit for sowing wheat on them in the spring; and it is uniformly observed, that the grain of wheat crops, sown upon regular fallows in September, or early in October, is of the best quality, owing probably to their reaching maturity earlier, and receiving the greatest heat of the sun.

Mr Cuthbertson of Seton Mains, informs me, that on consulting with several very intelligent farmers, it was their universal opinion, that there could be no mode of management introduced upon a strong clay soil, so proper, or so profitable, as fallow. Where land is improper for the growth of turnip, how is the soil to be kept clear of all the noxious substances which infest such soils, but by fallow? It is certainly true, that beans are a crop well calculated for strong soils, after they are put in good order, and an excellent preparation for wheat; but at the time when beans are required to be sown upon strong soils, no opportunity whatever is afforded to the farmer, of effectually cleaning the land of couch-grass, and other weeds, which will always be propagated in abundance, where summer-fallow forms no part of the system. Were peas or beans to be sown even so late as the end of May or the beginning of June, still it would be impossible, in the short space of dry weather which may

usually be calculated on, previous to that period of the year, to clean the land in such a way, as to supersede the necessity of a summer-fallow.

To cultivate beans for winter fodder, would be procuring that article at a great expence indeed. They could never, to whatever purpose they might be applied, indemnify the farmer for the expence of working the land, and sowing a crop, which requires to be seeded at the rate of six firlots *per acre* when sown in drills. No abatement in that quantity of seed could be made, for if the crop is to be cut early for fodder, thick sowing would become the more necessary to hurry it on, so as to enable the farmer to cut it down, before the period of the regular corn harvest takes place. The best rotation for a clay soil, Mr Cuthbertson considers to be, 1. Fallow; 2. Wheat; 3. Clover and rye-grass for hay; 4. Oats; 5. Beans, or yams with dung; 6. Wheat, and then to return to fallow: a full crop of rye-grass and broad clover, either for soiling or hay, would go much farther in feeding horses or cattle, than any of the green crops that can be raised on a clay soil: Clover and rye-grass is always a sure crop upon such a soil, when the land has been previously prepared by a well-managed summer-fallow, and the sowing and labour are not nearly so expensive.

Mr Shirreff states, that a greater quantity of straw, and consequently of putrescent manure, will be obtained in six years, with a fallow year, than in seven with no fallow, owing to the superior state of fertility in which the land is put, by the operations of the fallow year.

Mr Somner of Gilchriston maintains, that fallowing clay land, places it, not in an unproductive state, but quite the reverse. When land of that description is properly fallowed; it will produce, under a rotation of six crops, one-fourth more of corn, straw, or grass, with the same quantity of

manure, than the same land would have done if no fallow had taken place. Mr Somner farther thinks, that when the land is in grass, stock is so much fonder of it, that in the same field, the land that has been fallowed will be eat bare, when the other is neglected; an opinion which I understand is a very general one with Scotch farmers. The land also is much easier kept clean, and easier ploughed and harrowed during the rest of the rotation. Clay soils in general are wet: Ploughing such lands, therefore, a second furrow in spring, (which must be the case occasionally where fallowing is neglected), is often attended with very injurious consequences; whereas, after a proper fallow, one furrow, judiciously given, is much safer, and in most cases will be sufficient for each crop in the rotation. Fallowing seems to have the property of making clay land tender and mellow, and of improving rather than exhausting it. On such soils, a well-prepared fallow may be justly called "*the groundwork of good husbandry.*"

On the subject of fallows, the late Mr Scott of Craighlockhart, one of the most intelligent and experienced farmers in Scotland, was decidedly of opinion, that naked fallows, in many cases, were indispensably necessary. He asserted, that stiff stubborn tilly land, intended for a wheat crop, never could be sufficiently pulverized, without undergoing that process, and that the manure applied could not operate with the same effect, when under a drilled crop, as when under a fallow. The consequences frequently were, that the crop of wheat, after the fallow, more than equalled, both the drilled crop, and the one that succeeded it; and what is of great importance, the land which had been summer-fallowed, was in better order, and in a higher state of productiveness, than the land which had carried a drilled crop. He contended, therefore, that moist or stiff soils, over-run with weeds, which propagate from the roots,

could be effectually cleared of them, solely by a naked fallow. Indeed, I have seldom seen a Scotch farmer who entertained a different opinion.

Mr Kerr considers the grand objection to all substitutions for a naked fallow on clay soil, to be, the impossibility of eating the crop on the land, or carting it off during winter, without totally subverting the whole benefit of the fallow work, which had been given to that substituted fallow crop.

Another correspondent, (Mr Wood of Millrig), states in the most decided terms, that naked fallow has paid him much better than drilled crops, the bean in particular, the roots of which take away the nourishment of the earth where the clover-root is fed. The bean is also a great encourager of the white snail, a determined enemy to red clover.\*

Mr Wight of Ormiston is likewise of opinion, that a naked fallow pays better than a drilled crop. He has had

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\* Mr Wood, in another communication, contradicts the doctrine, that clovers will not continue to thrive well in rotations of four or five crops. He declares, from many years experience, that there is little or no danger of clover succeeding every fourth or fifth year, provided a complete summer-fallow intervenes betwixt the clovers; but if green crops are to serve as a substitute for a fallow, he has found, in that case, in the same field, the clovers give way, when they succeeded on the fallow part of the ground, the green crop roots taking away that nourishment which is necessary for the support of the clover plant, and perhaps, being of the same nature, that may have some effect. He could clearly see it is the farmer's interest to make almost any sacrifice to ensure red clover, as it can easily be reduced into calculation, that it is the best crop, when pastured judiciously, for nourishing the earth, the roots being upon an acre more weighty than the weight of beef or mutton fed from it, consequently it is great gain, when the roots make up for what is taken from the surface. It is probably the new earth turned up in the operation of fallowing, which renders the clover plant so successful.

frequent occasion, in the course of fallowing, to plant some potatoes upon some part of the fallow field more adapted for drill crops than the rest. The ground thus planted, was always dunged with stronger, and a greater allowance of manure, than the naked fallows. The wheat crop after the naked fallow was much heavier, and more luxuriant, than that after the potatoe, although the wheat after the potatoe was superior in quality. The after crops of the rotation upon the naked fallow, were throughout superior in every respect to those after the potatoe, and the land much cleaner in the end.

Nor is it the least important advantage of a fallow, that less dung is necessary, to produce the same effect, whilst lime may be applied, and with a greater probability of success, than in any other stage of the rotation. If dung is laid on a fallow, and well mixed with the soil, its operation is instantaneous, as the whole pores of the soil are then open to receive the nourishment that is administered. I must, at the same time, remark, that in those districts of England, where fallowing is practised, the application of dung to the crop of beans is becoming a favourite system. That experienced and respectable Border farmer, Mr George Culley, is of opinion, that dunging naked fallow is totally unnecessary, (except on very lean hungry clays), and most commonly injures the succeeding crop of wheat, by making it too luxuriant. On the dunged land, there may be more stooks in the field, but there will be fewer bushels in the barn, than if the land had been limed and no dung given. This is also the opinion of some Scotch farmers. Mr Andrew of Tillilumb, near Perth, when he fallows, *gives no manure*, as he finds that fallow wheat with manure is apt to be too luxuriant. Mr Allan of Craigrook, near Edinburgh, also prefers fallow without dung. Where land is of a good quality, Mr Wight of

Ormiston has frequently experienced, that a well-prepared fallow will produce a superior crop of barley, without dung, to that produced with it, both upon naked fallow and after potatoe. Mr Dudgeon of Prora likewise contends, that if the land is of very good quality, a well-prepared fallow will often produce better wheat, without dung, than with it. It is proper, however, to add, that in general this can rarely happen, unless an over-doze of manure is bestowed;—a practice which every good farmer studiously avoids.

Besides these advantages, fallowing is supposed to contribute materially to the destruction of snails and other vermin in the ground, not only by destroying them and their eggs in the course of the operation, but also by exposing them to the attacks of rooks and other birds. Nor is it improbable that something of a fertilizing quality is added to the soil, or at any rate, that something obnoxious to vegetation is extracted from the soil, by exposure to the atmosphere.

In addition to all these authorities, it may be proper to add that of Mr Brown of Markle, to whom I am much indebted for many useful observations on the several sections of this work, and on the subject of fallows in particular. In his valuable *Treatise on Rural Affairs*, he declares it as his opinion, that without summer-fallow, conducted in the manner already described, perfect husbandry is unattainable on all heavy or cold soils, and upon every variety incumbent on a close or retentive bottom;\* and Dr Coventry, after considering the objections which have been urged against summer-fallowing, the abuses to which it is liable, and the advantages attending it, very justly observes, that the discordance of practice and opinion respecting it,

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\* See Brown's *Treatise on Rural Affairs*, vol. i. p. 191.

is principally owing to circumstances not having been correctly discriminated, or to differences in respect of soils, seasons, climates, &c. He adds, "*that there are certain situations, in which it cannot be advantageously relinquished for any other process of tillage whatever.*"\*

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\* Introductory Discourses, p. 70. Dr Coventry has more fully explained his sentiments on this important subject in the following words: "A summer-fallow," he observes, "may, in most instances, be employed in the commencement of a course of good culture, and in several cases, it may even be occasionally introduced during its continuance. In the former, it may be found requisite for the following purposes: to have a better opportunity than otherwise, of removing all wetness, stones, or other obstructions to perfect tillage; to render the land, to a due degree, clean of weeds, and of a proper texture; and to get the surface so adjusted, as to have no injurious inequalities, or any thing that can prevent the ready discharge of water from it, and the employment of the best mode of raising and collecting the crops from it. In the latter, it may be had recourse to where fallow crops could not, in comparison with it, be advantageously retained, from whatever cause. The circumstances that chiefly render it necessary or proper, to retain summer-fallowing in the course of management, are those which arise from the character of the *climate*, and the nature of the *soil*, jointly. Whenever it is a dry, free soil, on a sound under-ground or bottom, as a loam well replenished with mould, or a sandy loam, or a gravel or sandy soil, or any other of a description suited to bear turnips or potatoes, then, after having been once made clean, it may, by fallow crops, seasonably employed and well conducted, be afterwards preserved in good condition, and fallows become unnecessary. But, on the other hand, wherever it is a loamy or clayey soil, or a retentive subsoil, or one apt to be wet, some difficulty occurs as to its application and management. There are two things which especially merit attention in such kind of land. These are, the *climate*, and the *degree of fertility* in the soil itself. If the situation be high-lying and cold, then the only species, beans, and perhaps cabbages too, might be found unfit for cultivation. The unfavourableness of the climate might not permit beans to ripen, or become of much value as a crop; and cabbages, in a late, cold situation, whatever may be the degree of fertility in the soil, may not be eligible for culture; inasmuch as

It may be proper also to add, that Mr Curwen, who, at one time, was strongly prejudiced against naked fallows, when he saw the crops which resulted from that process, and heard the arguments in its favour, from individuals, second to none for intelligence, and skill in their pro-

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they may not continue through winter in good condition, and at any rate might then be with difficulty removed from the ground; and, if they were at all of any material benefit, they would require to be made use of in the beginning of winter, a period so limited, as greatly to diminish their value to the cultivator. Probably, therefore, in most clayey lands, situated 400 feet or upwards above the level of the sea, where the climate is cold, and the harvest late, fallow crops will be found unsuitable. In lower-lying grounds, again, it will be found that the soil must possess a certain degree of *fertility*, before fallow crops of beans, or any other species adapted for a clayey soil, will so far answer, as to admit of being raised on a large scale, and to become preferable to a summer-fallow, with the total loss of a crop for the year. Where the land is poor, or the means of rendering it duly productive, manure namely, is not at hand, the bean or cabbage crop, or any other such, might prove, comparatively, of no great value; and on such land, the seed of the wheat crop that succeeds them, would require to be earlier sown, to ensure success from it as a crop. A fallow, well conducted, will be more favourable for the timely sowing of the wheat seed, than tillage with and after beans, poor crops of which might not compensate for the injury that might be produced by the delay in the wheat sowing,—a consideration which will be admitted by those, who understand the advantage derived from a summer-fallow, in giving a superior tilth to the land, above what can be done with a fallow crop. Most probably, wherever a clayey or loamy soil, is so poor as not to yield five Lothian bolls of beans, (20 Winchester bushels), *per* English or statute acre, it had much better be cultivated by a summer-fallow, than by any such fallow crop. If it possess such a degree of productiveness, as to yield seven bolls, or 28 bushels, of beans *per* acre, then that fallow crop may take the place of a summer-fallow, either occasionally or more constantly; and it might do so almost constantly, on land that has been once rendered to a full degree clean, if the fallow crop be employed at proper intervals, not at too distant periods, and if its culture be properly managed. Again, should the

fession, could not but question his own judgment, and to doubt it rather than theirs. He confesses himself therefore much shaken in his opinions. His practice has been, to make the intervals of his green crop so wide, as to admit of a great deal of cleaning; but yet he candidly acknowledges, that he cannot shew his land, in equal order, with what he observed in East Lothian and Berwickshire-Fallows, he observes, are generally done in so slovenly a manner as not to deserve the name. Before deciding on their utility, Mr Curwen, with great propriety, urges their being attended to with the same care and attention that is practised in East Lothian. Indeed, in a district where such rents are paid, (the greatest in the united kingdom), whilst summer-fallow is steadily maintained, and judiciously executed, the boldest theorist should pause, before he pronounces decidedly against a practice, the beneficial consequences of which are thus strikingly demonstrated.\*

4. *Cases where fallowing strong lands is not practised in Scotland.*—Near towns, where manure abounds, and rents are high, the fallowing process is avoided as much as pos-

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fertility of the land be above the degree mentioned, so as to bear nine or more bolls, or about 36 bushels of beans, or a produce of cabbages corresponding to that amount of beans, then such fallow crops, correctly managed, and not otherwise, may, with advantage, totally supersede the employment of any summer-fallow. Many husbandmen have relinquished, with great benefit, on clay soils, naked fallows for fallow crops, namely, such as are raised in rows, and capable of being properly cleaned by horse-hoeing; and others have done so without any gain, and some with direct loss; and both the errors in practice, and the discordance in opinion on this matter, must be referred, to a want of due discrimination in the difference of cases."

\* See Report of the Workington Society, for the year 1810, p. 83, &c.

sible. In the neighbourhood of Glasgow, where rents are from L. 6 to L. 7 *per* Scotch acre, (from L. 4, 15s. to L. 5, 10s. *per* English acre), several thousand acres of land, even of a clayey quality, are cultivated under the following rotation, namely, 1. Potatoes; 2. Wheat; 3. Clover; and, 4. Oats. The potatoes get from thirty to forty tons of dung *per* acre;\* but the wheat gets only a moderate dressing of hot lime. Under this, and other rotations of a similar nature, it is admitted that the land is apt to get foul, and to require a naked fallow, but the farmers have an aversion to that mode of improvement, substituting in its stead, what they call a *bastard-fallow*, that is, three furrows after the clover has been harvested; the land is then sown with wheat, after getting a small quantity of dung.

An intelligent farmer near Edinburgh, (Mr Gray of Gorgiemuir), adopts the following rotation on his strong lands: 1. Potatoes, after being well cleaned by repeated ploughings, &c. and manured with from forty to fifty cart loads of Edinburgh street dung, thoroughly mixed with his farm-yard dung; the produce from forty to sixty bolls of potatoes † *per* acre, (from 860 to 540 Winchester bushels *per* Scotch, or 288 to 432 *per* English acre). Where there is too great a proportion of clay in the soil, to grow potatoes with advantage, then *yams* for horses are planted, and the land is always kept in open drills, from the planting to their being taken up; that is to say, without harrowing

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\* It is remarked, that this is a very abundant dressing indeed, and can only be given in the neighbourhood of a great town. In Berwickshire, twelve cart-loads is reckoned a good manuring once in three crops.

† The Edinburgh potatoe boll is 400 cwt.; consequently five bolls make a ton.

them down, as the others are done ; if it is not a very wet season, the produce is from thirty to forty bolls *per* acre, equal to from 270 to 360 Winchester bushels *per* Scotch, or from 176 to 288 *per* English acre. This he considers to be preferable to the crops of beans he used to have on the same land: 2. After potatoes or yams, then wheat, (drilled, where the soil is light, by Cook's machine), and sown with grass seeds in the end of March, or beginning of April: 3. Clover, twice cut ; and, 4. Oats.\*

5. *Miscellaneous Particulars.*—The crops which may be cultivated on strong lands, instead of a naked fallow, are, 1. Beans ; 2. Peas ; 3. Tares ; 4. Potatoes or yams ; 5. Swedish turnips ; 6. Cabbages ; and, 7. Rape or cole seed. The question is, whether any of these crops will be more profitable to a farmer, than three bolls of wheat, or twelve Winchester bushels of additional produce *per* Scotch acre, (about nine and a half bushels *per* English acre), together with those other advantages attending fallow, in the course of five successive crops, which have been already pointed out ?

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\* This idea of cultivating yams instead of beans, on very strong lands, merits particular attention in this part of the kingdom, as a bean crop fails so often. Regarding the culture of yams, the late Mr Scott of Craiglockhart observed, that of late years *yams* have been by many substituted for the evening feed of horses. If work-horses can subsist to equal advantage, partly on yams and Swedish turnips, what a promising prospect for increasing the growth of wheat, and bringing fields to a high state of cultivation without losing a crop ! One acre of yams, or Swedish turnips, will afford more subsistence for either horses or cattle, than two of oats or any other grain: On the other hand, it is said, that, generally speaking, one-fourth more wheat will be grown on strong land, after fallow, than after Swedish turnip.

1. Beans are certainly calculated for strong soils, being an excellent preparation for wheat, and when drilled, they also enable the farmer to keep his lands clean; but the crop is seldom sufficiently early in Scotland, to be safely harvested in wet seasons. Mr Robertson of Ladykirk justly observes, that our southern neighbours have much the advantage of us in the bean husbandry. The great source of distress attending bean crops with us, is *their lateness*. In passing through the country near Aylesbury, he saw their beans *covering* the ground, and all in bloom, on the 14th of June. Our wet weather generally commences about the 20th of October. Before that period, the winter wheat in Scotland should all be sown, but the beans are often in the fields. There can be no doubt, that fallows might be reduced in number, were drilled beans more carefully cultivated; but the climate of Scotland will not admit of it, at least to any great extent. It is contended, at the same time, that the straw of an English acre of beans, if cut down merely as fodder, would be worth L. 5, and that if used as litter merely, it would produce at least 120 stone, which, converted into dung, would manure half an English acre. It is questionable, however, whether it would be advisable, to run the risk of losing the benefit of a well-prepared fallow for such advantages.

2. Peas might be cultivated on strong land, either for the seed, for fodder, or for litter; but if the crop should not answer, (which often happens), there would not only be no profit, but the ground would be instantly filled with all kinds of weeds.

3. Tares are liable to the same objection, and, unfortunately, the winter tares are not calculated for the climate of Scotland, otherwise they might be cut so early for soiling, as to furnish an opportunity, in the end of summer, or beginning of autumn, to clean the land.

4. Potatoes or yams may be raised on strong land, but not to any great extent. They require to be sown so early, that not one year in ten will the season admit of root-weeds being completely eradicated; and in wet autumns, how are they to be taken up? It is the opinion also of the most intelligent farmers, that it is impossible to make foul ground clean, with a crop of potatoes or yams, though if once thoroughly cleaned, it may be preserved in that state, by crops of potatoes and yams, for many years.

5. Ruta бага, or Swedish turnips, may be raised to advantage on strong soils. They may be sown in the end of May, and taken off the field in September. They are also easily preserved till wanted; but if taken off early in the season, the crop will not be abundant, and there is great risk, when the crop of wheat is afterwards laid down, that the land will be in bad order. If barley, however, were to follow Swedish turnip, that objection would be removed, as the land might, in that case, have both winter and spring-ploughing. The following rotation might in that case be tried: 1. Ruta бага; 2. Barley; 3. Beans; 4. Wheat; 5. Clover; and, 6. Oats. It is objected, however, to this rotation, that ruta бага increases considerably in size, till checked by the strong frosts in December; consequently that if it were taken up in September, it would occasion a great loss of weight and value in the crop; and that the wheat crop, after plain fallow, would probably exceed in value, both the ruta бага and the barley: a loss rather than a benefit would therefore arise from omitting summer-fallow.

6. Cabbages, properly cultivated, yield a great quantity of food for cattle; but they are not calculated for an extensive scale of farming. With cabbages, a certain proportion of ground might be appropriated to the cultivation of green kale; the one for food in autumn, and the other in March and April, which are the most hazardous months of the

year to the farmer, and the most difficult to provide for. Some maintain, that cabbages do not exhaust the soil, if drawn before the white fibres shoot out from the roots in spring, that is, so long as they can be pulled up with ease; but by others they are regarded as the most scourging green crop that can be cultivated.

7. A most intelligent correspondent on the borders, (the late George Culley), informed me, that the best way he ever knew of treating clay soils is, instead of a naked fallow, to sow rape or cole, (as it is called in the southern counties of England), in drills, with a little dung in the drills. The crop may be eat off in August, or the beginning of September, and then wheat may be sown.\* This is the method he generally prefers with clays, instead of a naked fallow, and he never saw more beneficial crops of red wheat, than he has thus obtained upon poor clays. The rape was fed where it grew, and after making *cast* or *culled ewes* as fat as bacon, (indeed nothing of the vegetable tribe will feed sheep so quick as rape in autumn), he immediately ploughed it, and sowed invariably *red wheat*, as being the hardiest sort for poor clays, and he never missed a fair crop, and much safer and better than he got on naked fallows; namely, from 23 to near 32 Winchester bushels *per* English acre. He well remembers a crop of red wheat, upon one of these poor clay fields, got in the year 1795, after rape sheep-fed, which crop was fully worth the value of the land it grew upon, wheat indeed being very dear that year. The circumstances of this statement, coming from such respectable authority,

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\* Might it not be eaten off in spring, and sown later? The rotation would then be,—1. Rape, 2. Barley, 3. Clover, 4. Oats, 5. Beans and Peas, 6. Wheat. What a resource *in spring*, would not the rape be, for feeding stock, and in the dry spring months, even clay land might be fed with sheep, without detriment.

cannot be questioned ; at the same time it is hardly possible, that the ground could be placed in that husbandman-like condition, by the culture given to the rape crop, as by a naked fallow. To decide the question, it would be necessary to fallow a part of the same field, and to compare the future produce of the part that grew rape, with that which was fallowed. Nor will this plan, it is said, at all suit a farm entirely consisting of clay, and consequently not calculated for a sheep stock. It would be a dangerous and imprudent experiment, to purchase sheep for the consumption of a few weeks food, and to be compelled to send them to market, when the rape was finished, in September.\*

These hints are submitted to the consideration of intelligent farmers, who may be of opinion, that notwithstanding the great improvements that have been made in agriculture, it is still capable of amendment, and that it cannot be brought to the perfection of which it is capable, without ample discussion, and repeated experiments. It must be admitted, that though fallows are now in a manner exploded by many of the ablest farmers in England, more especially in the counties of Norfolk and Suffolk, yet the greater moisture of the Scotch climate, seems to render them so necessary in our wet and tenacious clays, that Mr Rennie of Phantassie emphatically calls them “ the main-spring of the husbandry of Scotland.” But though fallows seem to be necessary in this country, yet, in process of time, their frequency may be diminished. The climate may improve as cultivation is extended : By perpetual accessions of lime and dung, the texture of our strong soils must be altered, and will become more of a loamy nature : By repeated cleanings, the quantity of weeds of all descriptions must be

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\* Farmer's Magazine, June 1812, p. 237.

greatly lessened : Instruments also may be invented, which may prove more effectual for cleaning and pulverizing the soil, than those at present in use : New plants may likewise be discovered, or a more advantageous mode of cultivating old ones : Nor is it possible to foresee, what improvements may be effected by draining, in consequence of which, the cultivation of wet soils may be facilitated, and either stock may be fed upon the ground, or its produce may be removed without injury.

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SECT. V.—*Of the Crops usually cultivated in Scotland.*

THE crops principally cultivated in Scotland, are, 1. Wheat; 2. Barley, including bear or big; 3. Oats; 4. Peas; 5. Beans; 6. Tares; 7. Turnips; 8. Potatoes; and, 9. A mixture of Clover and Rye grass. Some carrots, and in particular instances, cabbages, kale, rye, and flax, are also occasionally cultivated; but none of these articles find a place in the general husbandry of Scotland. As this work, is not intended to be a treatise regarding every point connected with agriculture, but, in a great measure, a condensed statement of the information transmitted to me by the farmers in the more improved districts of Scotland, regarding the systems of husbandry pursued by them, it is proposed, in general, to take notice only of such particulars, communicated to me in the course of my enquiries, as seem to be entitled to attention, unless where it may be necessary, to add some remarks regarding the practices of England, by way of illustration.

1. *Wheat*.—The growth of wheat has greatly increased in Scotland. It is not only more frequently introduced into rotations, but it is also cultivated in many districts where it was formerly unknown; and in situations, where, from their elevation, it was formerly thought impossible to raise it. In the parish of Temple in Mid-Lothian, for instance, it has already been grown, from 500 to 600 feet above the level of the sea, and some are trying it, and it is said with success, even in higher situations.\*

There is nothing that seems more likely to promote the successful culture of wheat in Scotland, in districts where the soil is cold, or the climate unfavourable, than to sow it early in autumn. In a farm, which a tenant had declared, would not carry wheat, that he had tried it often, without success, a new possessor resolved to sow it on the 12th of August, and he had the satisfaction of cutting down his crop, on the 10th of August in the following year, and it would have been cut earlier, had the weather permitted. As it was, there was no farmer in Scotland, and few farmers in the northern counties of England, who had such a quantity, as 300 bolls of wheat, cut down so early. It proved of uncommon good quality, and sold at a high price, for seed.†

In regard to the more fertile districts of Scotland, the general opinion of Scotch farmers is, against sowing wheat so early as the month of August. By one of them, who has sown wheat to a great extent for thirty years, I am informed, that he has tried every period of the year, from the middle of August, to the middle of March; and by the result he is firmly convinced, that the latter end of September is

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\* Communication from Mr George Farme of Braidwood, near Dalkeith.

† Communication from Mr Allan regarding his farm of Oldliston.

the most appropriate time for sowing wheat on clay soils, if the weather will admit of it. But good crops may be got sown long after that time, if the weather is favourable.

An intelligent farmer strongly recommends kiln-drying seed-wheat, as a better means of preserving the crop from smut, than the usual practice of pickling or steeping. From eight or nine years' experience, he states, that it has been found at least an equal preventive against the loss produced by that disease; and allowing it had no superiority over the method more generally in use, in respect to that property, still it would be entitled to a preference, because it can be kept without injury, should the weather turn out unfavourable for sowing at the time intended, which is not the case with wheat prepared in the other way; for unless it be sown almost immediately after pickling, it becomes unfit for seed,\* and can scarcely be applied to any other purpose. Wheat, to be prepared for seed by kiln-drying, ought to be completely dried, but not subjected to a heat which might in any degree scorch it.† This information is strongly corroborated by the evidence of Mr Fowler of Prestonpans, who has in one year prepared 40 bolls of wheat in this way for seed, and who has no doubt of its answering effectually. The process, however, requires so much attention and skill, that it is not likely to become general, and the usual plan, when properly executed, is found to be effectual.

An important particular connected with the culture of wheat in Scotland, is the practice of sowing winter wheat in the spring months. The late Mr Shirreff sowed winter

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\* This point will afterwards be more fully discussed.

† Communication from Mr James Cuthbertson of Seton-Mains. This plan is mentioned in the original report sent to the Board of Agriculture, regarding the county of Clackmannan.

wheat in spring, with success, about the year 1773. Mr Brown of Markle states, that he commenced this practice as far back as the year 1779,\* as did his neighbour Mr Rennie of Phantassie, about the same period. Above thirty years ago, Mr Wight of Ormiston successfully tried the practice upon clay soils. The same plan had been adopted by several people before, but not to any considerable extent, and only in seasons when, owing to the wetness of October, it could not be sown at the customary time. It is of great importance to be able to sow wheat after turnips, for the month of March is not found too late when the season is favourable. Mr Rennie of Oxwell Mains, in East Lothian, who possesses a farm of an excellent soil, and in a favourable climate, informs me, that his March-sown winter wheat, *anno* 1809, was as good, both in respect to quality and produce, as what was sown in November and December. He adds, wheat sown in autumn very frequently lodges in moist seasons,† and on that account is deficient both in quantity and quality. This, however, only happens on rich soils. On wet soils, the farmer often sows early in autumn, not from choice, but lest he should lose an opportunity of doing it. In regard to the difference of produce

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\* Mr Brown farther informs me, that in 1800 he had above 140 English acres of land sown with wheat in the months of February and March, all of which yielded grain of the finest quality. This was completely ascertained, in consequence of his having been a candidate for a premium offered that year, by the Society of Arts, to the cultivators of spring wheat, which premium was adjudged to him. He adds, that the summer of 1800 was particularly dry and warm, and that to these circumstances must in a great measure be attributed the goodness of the crop.

† The lodging of the autumn-sown wheat may be owing to the crop being too thick. Three bushels *per* Scotch acre, sown in October, is equal to four bushels sown in March, on account of the latter not stocking, and the straw, from the thickness of the crop, proving weak.

between autumn wheat, and the same kind sown in spring, Mr Rennie thinks, that in ordinary seasons, the spring-sown is equal in quantity on light dry land, but is not to be depended on where the soil is wet, or the climate unfavourable, nor is it so early ripe as that raised from seed sown in autumn.\* What is called brown wheat is reckoned the best

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\* Though not strictly connected with the subject of Scotch husbandry, I cannot deny myself the pleasure of inserting the following note, containing some particulars transmitted to me by that celebrated farmer, George Culley, regarding the spring culture of winter wheat.

“ Respecting the sowing of winter wheat in the spring, after turnips, I can speak in a very full manner, as I am persuaded very few farmers in this island have had more experience of that practice. I believe that spring-sown winter wheat, had not been much tried in this county, before my late brother and I settled in Northumberland in the year 1767. We had made some small trials of it in the county of Durham before coming north; immediately on our taking Fenton farm, however, we tried it upon a pretty large scale, namely, from 100 to 200 acres in the year. But for many years after, having extended our farming concerns, we seldom grew fewer than 500 acres and upwards annually, and with never-failing success, one year excepted, when a partial mildew took place, and until those last three fatal years, when most of the wheat in these northern parts of the island, have been more or less affected with that dreadful malady! Not that spring-sown wheat was more hurt than the winter-sown, but perhaps less injured upon the whole. Nevertheless, I do not know, whether I ought to recommend it to be much sown in the southern counties or not, because, in the trials we made in the county of Durham, we had nothing like such plentiful crops as we produce here.

“ Besides, in the county of Durham, and all the way from thence to the southward, they can grow more barley in quantity, and better in quality, than we can by much, and it is also always much higher sold; consequently the growing of spring-sown winter wheat after turnips, becomes not so much a matter of consequence to them. Allow me to remark one thing, which I cannot account for; we can perhaps produce the best oats of any in Great Britain, and yet we grow very indifferent barley. Perhaps, not only the friable fertility of our turnip soils in Glendale Ward, but the vicinity of the mountains, may be favourable to the production

for spring-sowing, being early, productive, and less apt to suffer from rust or mildew. This kind may answer when the white sorts would fail.

The real spring or summer wheat, has been of late introduced in various districts in Scotland. It possesses some advantages, being for a much shorter period in the ground; and though sown in the end of April, or the beginning of May, will ripen as early as winter-sown wheat. It is certainly, however, not so productive as wheat sown in winter, or even winter wheat sown in spring; and the ear being shorter, the crop cannot be equally productive. If found

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of spring-sown wheat. Perhaps a more rapid vegetation takes place in the vales adjoining mountainous districts, than at a distance from them. It is very proper in you to say, 'winter wheat sown in spring,' because a discrimination is highly necessary between winter wheat sown in the spring, and the Siberian, or real spring wheat. We tried the real spring wheat several years; but in both quantity and quality, it was invariably much inferior to the winter wheat sown in spring.

"Prior to our coming into this district, no wheat was grown in Glendale, except in the haughs by the river sides, or some particular pieces of strong land, unfit for turnips. But now, and for many years, thousands of acres of spring-sown wheat have been grown with the greatest success, which had never produced any wheat before; and until these last unfortunate years, we seldom produced less than from three to four quarters *per acre* after turnips, and frequently more. Upon the weaker turnip soils, we *ourselves* sow a red wheat, the seed of which we got several years since from a village called Burwell, in Cambridgeshire, an excellent and productive kind."

Mr Culley adds, that he has known winter wheat do pretty well, when sown even in the beginning of April, but he does not approve of it. There is no fear of a plentiful crop, but it is so late in ripening, that six times in seven it suffers from the equinoxial gales; and he is decidedly of opinion, from long experience, that the best time, or season for sowing autumnal wheat in the spring, is February, and the first ten days in March.

to answer, it would be a great acquisition in districts, where sowing winter wheat has not succeeded.

It is of great importance to try new varieties of wheat, at first on a small scale, but to be extended afterwards if found to answer. Mr Wight of Ormiston informs me, that he had lately occasion to see a very fine close luxuriant crop of wheat growing in a field of high exposure, and thin land. He was informed that this wheat was early, could be cultivated on fallow without dung, and that it possessed a quality which no other wheat had, that of not being liable to be thrown out of the ground during the winter by frost. Hence it had acquired the name of "the creeping wheat." It will produce at the rate of 8 Linlithgow bolls *per* Scotch, or 26 Winchester bushels *per* English acre. Such a sort of wheat, may be of infinite consequence in our more northern districts. In the southern counties, it would be well worth while to try the best sorts of the celebrated Dantzick wheat, which sells at so high a price, and which is probably hardy enough to be cultivated in favourable situations. It may be difficult, however, to procure it, in a state capable of vegetation, as it is generally old wheat that comes to our market; it is sometimes kiln-dried, and at other times, previous to its being shipped on board the craft in the Vistula, spread out on sails, and dried hard in the sun. The excellence of Dantzick is probably owing to the heat of the climate, but still a change of seed, from a better climate, may prove highly useful.

In regard to the culture of wheat in general, many intelligent agriculturists begin to be apprehensive, that from the high price of that article, farmers have been tempted to sow it too often, and that it comes round too frequently in the rotation, which may contribute to those diseases which have of late affected that species of crop, to an extent never formerly known in Scotland. It is remarked, at the

same time, by Mr Pringle of Ballencrieff, that in East Lothian he does not observe the crops of that grain falling off, though they are more frequently introduced than formerly; in many instances, once in three years. The failure, for four years past, was entirely owing to the coldness and wetness of the weather.

2. *Barley*.—This species of grain was formerly the great favourite of Scotch farmers, but it is not so much run upon as formerly, since crops of wheat, by the introduction of fallows, have become more certain and productive. By some barley is condemned, as the least advantageous of any of the white crops, being neither so prolific as oats, nor so profitable as wheat. It is remarked, that all crops exhaust the soil, in proportion as they are heavy in grain upon the acre, and produce the least weight of straw, to be converted into manure. Hence barley ought, in general, to be accounted a more severe crop than either wheat or oats, because the straw gives, neither equal food to the animal, nor dung to the earth, and of course is not so profitable to the farmer, unless upon particular soils. It is also contended, that land is not more exhausted by wheat than by barley, if these crops are raised either after fallow or turnips. On the other hand, it is maintained, that though on very strong or very rich land, a greater quantity of oats than of barley may be grown, yet upon good dry land, and after turnips, as much, and in many seasons more barley will be grown than oats; and on such soils, that barley is found to be more profitable than even wheat, producing from 40 to 50, and in some cases even 60 bushels *per* English acre. It is also to be observed, that as great quantities of turnips are left growing in the field, both for cattle and sheep, in the spring, no other grain but barley, can with propriety be

sown at that advanced period of the season.\* In late harvests also, which so often happen in Scotland, barley will ripen sooner than any other grain. The principal objection, therefore, to the growth of barley, is the uncertainty of the demand, arising from the unfortunate circumstance of its distillation being so frequently prohibited.

In many parts of Scotland, more especially in the northern districts, the culture of that species, called *bear* or *big*, is recommended instead of the two-rowed barley. An intelligent farmer in the Mearns assigns the following reasons for preferring bear: The crop of grass, he observes, is almost constantly good or bad, in proportion as the ground is more or less pulverized; and as bear may be sown three, or perhaps four weeks later than barley, it may be done, even in a northern climate, at a season when the land can be brought to a finer tilth. If the grain crop should happen to lodge, as bear will be sooner ripe than barley, and consequently earlier taken off the ground, the danger of rotting the young grass is less. In northern districts, the earliest grains ought to be cultivated; and barley is not only later than bear, but it requires to stand longer in the stook before it be fit for stacking. No doubt barley is the more valuable grain of the two; but that cannot be put in competition with the risk of a late and precarious harvest, and perhaps the loss, or at least the deterioration, of the two following crops of grass, by which, not only the food for cattle is lessened, but the land becomes fouler; since weeds will vegetate, if the land be not better occupied. The produce also from bear, will be found to be greater

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\* The real spring-wheat is certainly an exception, as it should be sown in the end of April, or beginning of May. It is a singular circumstance, that in many parts of Scotland, barley was the latest ready of all the crops of grain last season, (*anno* 1811.)

than from barley, (to the amount, it is said, of 20 *per cent.*), though this circumstance is probably overlooked by the farmer, as he generally sows the latter on his best land. On tolerable farms, the inferior land will yield nearly as much bear, as the best will barley; and had bear been substituted on the latter, the produce would have been much greater. But on ordinary land, yielding a tolerable crop of bear, there will be a considerable deficiency of barley.\* How unfortunate it is, that the culture of so useful a crop should

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\* Mr Grierson, late corn-merchant in Leith, who had much experience and knowledge in the corn-trade, transmitted to me some observations on the subject of feeding of horses with bear. He was of opinion, that bear was better for feeding horses than barley, and better than oats for horses, not much wrought, in dry countries, but not so good as oats in wet countries, or in wet roads, where horses require more heating food.† Horses, however, are fed to most advantage with beans and oats, ground as small as malt. It is hardly to be conceived, the difference of the ease to a hard-wrought horse, who has ground meal to eat, and one that has his oats to eat whole, as he has not half the time to rest, as the one that has ground corn, and cannot perform the same labour, or last so long. This is a most important consideration where so many horses are necessary for agriculture; and a very trifling expence would add a grinding-machine to the threshing-mills, for all the corn necessary for feeding the horses and pigs on a farm. That bear is not more cultivated, and in higher request, he was convinced, was owing more to prejudice than any thing else; for it is well known, that it produces more seeds than barley, and is less injurious to the ground; and may be sown for twenty years on the same ground in succession, without either lessening the produce, or impairing the quality, provided the land is fallowed before winter, and twice ploughed before sowing, with a sprinkling of dung or sea-ware. It is very seldom more than ten weeks on the ground in favourable situations, and barley never less than fourteen.

† According to this remark, big would be the best food for horses in England and Scotland, during the summer season, which would be a great point to establish.

be checked by improvident enactments, imposing a higher duty on bear, in proportion to its value, than on barley.

When barley was sown under the old system of management, without fallow, it was found necessary to sow it late in the season, for destroying a greater quantity of weeds; but now, when the land is cleaned so much both of seed and root-weeds, barley can seldom be sown too early in dry lands. Sowing it in the beginning of March is the best means of securing an abundant crop, and of superior quality. Mr Wight of Ormiston has often seen barley sown on the winter-furrow, early in March, and it never failed to produce an abundant crop, particularly upon clays. It is remarked, however, that with early sowing there is less straw. Some farmers contend, that clover succeeds better after wheat than after barley, owing to the straw being stronger; but that opinion is contradicted by the experience of many respectable practitioners, who state, that in a dry spring, it is almost impossible to make grass seeds vegetate among winter-sown wheat, unless it is very strongly harrowed. Clover always succeeds best with spring-ploughing, and hardly ever fails after barley, unless that crop is lodged: to guard against too weighty a crop, less seed should be used.

3. *Oats*.—There is no species of grain that succeeds better in Scotland than the oat, and it is the crop for which by far the greatest part of that country is the best calculated; indeed, taking the after crops into consideration, it will, on the whole, be found the most profitable. Convinced of the superior advantages of this crop, some farmers have given up sowing barley or bear entirely, except upon land that cannot be cleared of turnips till the months of April or May, as from two to three bolls more of oats may be expected *per acre*,\*

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\* Dr Young, near Stonehaven, informs me, that he has had 15 bolls

as the straw of it is much inferior, either for feeding live stock, or for producing manure, and as the sale of it is uncertain. Oats also are preferred, in some cases, even to wheat, as it has been found that sowing oats after grass, is more advantageous than sowing wheat, however profitable that article may be.\* Oats also are a better crop after peas, than even after grass.†

It is well known that various sorts of oats are cultivated in Scotland. Mr Thomson of Bewlie greatly prefers the potatoe-oat. Either after turnips, or after clover ley in good condition, there is almost a certainty of having a good crop of that sort; they ripen and fill very well, even when lodged, being strong in the straw, and they sell at 3s. *per* boll, (Teviotdale measure), higher than other oats. They will grow very well even in high inland situations, and cold climates, and if cut down in time, there is little risk of their shaking. In exposed and elevated situations, however, Mr Brodie of Garvald greatly prefers the red oat. They unite the advantages of earliness, good grain, and a power of resisting the wind, superior to any other; and by growing them, farmers are enabled to cultivate higher grounds, than otherwise they could venture to do, with every prospect of reaping the fruits of their labour. The only objection to them is, that they give very little straw, though it is of a fine quality. By some, the dun oat is strongly recommended, sometimes producing 12 bolls *per* Scotch acre. The straw is very bulky, and the grain is less apt to lodge

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of oats *per* Scotch acre, or 72 bushels *per* English acre, on a field of 17 acres, though two of these acres had never before been under crop.

\* Remarks by Mr Trotter of Newton, in Linlithgowshire.

† Remark by Mr Charles Alexander, Easterhaprew, near Peebles. It is proper to observe, that when a field is fallowed, any mossy part of it should be sown with oats instead of wheat.

than when the potatoe-oat is cultivated. The dun oat, it is said, stands the weather better, the straw being firm and hard; and it is less apt to shake during the harvest. The produce in meal is considerable, varying from  $15\frac{1}{2}$ , to even 19 pecks of meal *per* boll of corn, according to the season. Church's oats are recommended for ripening early, ten days or a fortnight sooner than the potatoe-oats. They are sown at the rate of about 6 Winchester bushels *per* acre, have yielded from 60 to 80 Winchester bushels *per* English acre, and in some instances even more. It would be very important to raise a species of oats without a bosom-pickle, as the grain would then be more equal in point of size and quality, and less liable to shake; and it is said, that a large plump oat of that sort is to be found in Lincolnshire.\*

4. *Peas*.—For some years past, peas have been a precarious crop in Scotland, principally owing to the continual rains in the month of August, which kept the peas constantly in a growing state, in consequence of which the pods did not fill till the frost came on. Had there been dry weather in the months of July and August, the crops would probably have been abundant.† It is contended, however, that even in drier climates, a crop of peas will not succeed, if sown on the same land, above once in ten years.

Some farmers, who find that clean peas will not answer, sow peas and beans mixed, with a hand-drill, the rows at twenty-seven inches distance, so as to admit the horse and the hand-hoe at discretion. Mr Hope of Fenton finds,

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\* Mr John Shirreff informs me, that the potatoe-oat, when first introduced, was of that description, and might have been preserved so, by accurate selection, and separate culture. By the same means it might be restored to that state.

† Observations by Mr Neil Ballingal, in Fife:

that this plan answers better than sowing these crops separately. Mr Kerr is of opinion, that mixing the two sorts gives very material aid in harvest, as the peas serve to bind the beans. Besides, it considerably improves the quantity and quality of the fodder, which is a circumstance of great importance.

It is surprising that the farmers near Edinburgh have not attempted to raise early peas, an article which sells at so high a price, in the Edinburgh market, during the month of July, though considerable quantities are supplied by the numerous gardeners in the vicinity. About twelve years ago, a gentleman sowed two acres with white peas, and sold the whole, by the middle of July, at L. 35 *per* acre. Immediately afterwards, he prepared the ground for turnips, which were sown by the end of that month, but unluckily the seed was bad, and the turnip crop almost totally failed. He had no doubt of his making from L. 40 to L. 50 *per* acre of the two crops, had the turnip seed been sound; and he would have persevered in that plan, had he not unfortunately died. To take a crop of turnips, after early potatoes, is a common practice in the neighbourhood of Aberdeen.

5. *Beans*.—It would be a great advantage to husbandry, were an early bean discovered, which would bear to the common bean, the same qualities that the hot seed does to the cold seed pea, as this would remove the principal obstacle to the bean husbandry in Scotland, the lateness of the crop. It is certainly lamentable, to see the bean crop out in the fields, while, with a better climate, the land ought to have been sown with wheat. Some improvements might be made in the harvesting of beans, which would lessen that obstacle to their culture. Mr Mitchell of Balquharn has, for that purpose, successfully adopted the follow-

ing plan: When the beans are ready for binding and stooking, he carts them off to an adjacent stubble field, if nearer to the stack-yard so much the better. The beans are kept there till they are ready to be stacked, and the farmer's anxiety in regard to his wheat seed, can be no excuse for harvesting his beans too early. It may be objected to this plan, that it occasions a great additional labour, and that there must be a certain loss in loading and unloading. To the first of these, the answer is, that ten hands, with six horses, if the fields are at a moderate distance, will shift ten acres in a day; no great sacrifice, considering the motive; and, with regard to the second objection, beans recently cut, are not very apt to husk out, and, with ordinary attention, the damage is inconsiderable. This plan is strongly recommended by the experience of Mr Brown of Markle, who informs me, that in the bad harvest of 1799, he had 75 Scotch acres of beans and peas in drills,\* few of which were harvested till the middle of December. He removed a considerable part to an open stubble field, and by employing a servant to keep the sheaves on their feet, the whole were safely stacked a few days before Christmas, in excellent condition.

Mr Blane of Blanefield, in Ayrshire, tried a most successful experiment with the culture of beans in 1810. He was prevailed upon by a new ploughman, who had lived in a district where beans were much cultivated, to try two acres and seven falls Scotch measure, with that crop. The

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\* That excellent plan of drilling beans was, it is said, begun at North-Berwick about the year 1770, in the neighbourhood of which place, weighty crops of this article are still cultivated. Some farmers, however, still prefer the broad-cast system, upon very strong stubborn clays, but erroneously. It is remarked, that beans cannot be planted too near the surface; if merely covered, it is sufficient.

seed was sown in drills, distant from each other from twenty-eight to thirty inches, on the 11th, 12th, and 13th of April. The quantity sown was twelve Winchester bushels, and both horse-hoeing and hand-hoeing were duly attended to. The months of May and June were dry, but the rain fortunately came on about the end of July, the blossoming became universal, exhibiting an uniform surface of stalks; in general upwards of six feet in height, many nine, and some even ten feet high. Many of the stalks had from 40 to 55 pods. The whole exhibited a sight, equally beautiful to the eye, and agreeable to the smell. Many fields in different parts of the county, (the season in general proving unfavourable to the bean crop), had been mown down for green food to horses, where there was not the smallest indication of beans. This crop, however, turned out very different, a rich and luxuriant crop having been cut down on the 4th of October, and safely secured in the stack-yard upon the 2d of November. The produce of clean marketable beans, from the two acres and seven falls, was rather above  $25\frac{1}{2}$  bolls, or  $102\frac{1}{2}$  Winchester bushels; he had paid for the seed 9 s. *per* bushel; and if he had sold the produce at the same price, instead of using the greater part of them in the stable, his crop would have yielded L. 46, 16 s., besides the benefit of the straw, which could not be calculated at less than L. 10 more. The crop was raised without the aid of dung, and after two crops of oats.

6. *Tares*.—This article is not much cultivated in Scotland, a few acres only on every farm being raised for soiling horses, between the cuttings of clover; but Mr Allan of Craigrook has carried it to a still greater extent, as he considers tares one of the most valuable and profitable crops he can cultivate. The proper time for sowing tares *for*

*seed* is about the second week of March,\* in drills about thirty inches wide; and three firlots of tares is, in that case, a sufficient quantity of seed, but it is thought better to sow rows of beans and tares alternately, as the beans keep up the tares; in that case, half a boll of tares, and the same quantity of beans, is sufficient for seed. On this subject, Mr Dudgeon of Prora remarks, that as tares are much earlier than beans, they should be sown on the surface when the beans are harrowed; this should not be done till the drilled crop is near breaking the surface.† Without this precaution, he has witnessed a great loss of tares in reaping. If they could be kept late enough for the bean,

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\* Mr Kerr observes, that the time mentioned is very proper for a crop of tares *intended for seed*. But what are wanted for cutting or soiling, ought to be sown at two or three times, to give a succession. The first as early in February as the season will allow, to come in immediately after the first cutting of clover. A second crop in the beginning or middle of March, to stand for seed. And a third sowing in the end of March, or beginning of April, to cut green for the horses during harvest. Beans answer excellently, to stake the tares intended for seed; but those which are meant to be cut green, ought to have a small admixture of oats; which both serves to hold them up, admits the air, aids the scythe, and increases the food.

It is a pity our Scotch climate does not answer for winter-tares. Mr Kerr tried them twice ineffectually; but was told they sometimes come forward to cut before clover, but very rarely. The earliest sown tares in spring, should, however, be of the winter sort, being the hardiest. Winter-tares, it appears, would answer if sown in September. That plan, however, can rarely be adopted, as it is seldom possible to get the land cleared from the former crop, and ploughed for the tares, so early in the season.

† Mr John Shirreff is of opinion, that beans should *not* be harrowed till they have broke the surface, and got several green leaves, when they become pliant, and bend to the harrow; whereas, if you harrow them when about to burst forth, you break them over, for the embryo plant is very brittle.

no method can be devised, by which a greater crop could be procured.

7. *Turnips*.—Drilled turnips is one of the great boasts of Scottish agriculture, and though the idea of drilling them was originally taken from the celebrated Tull, yet the precise mode of conducting this operation, now universal in this country, certainly originated in North Britain. Other attempts of a similar nature may have been previously made, both in England and Scotland, but Mr Dawson of Frogden is the individual, who first brought that practice to its present state of excellence.

The superior importance of this branch of husbandry, as practised in Scotland, cannot be questioned. It has given to light soils a value, which it would have been vain to have expected from any other leguminous crop yet known in this country. Indeed, nothing has so much contributed to the improvement of agriculture, as this valuable root. Though its immediate beneficial effects are sufficiently obvious, there are others perhaps of still higher importance, which are not so fully appreciated. It would be easy to trace its consequences through the arable and grazing departments of husbandry,—to prove that, for both the quantity and quality of our grain, and butcher-meat, we are greatly indebted to turnips. Perhaps we should be warranted in proceeding farther, and in attributing, in a considerable degree, to the general cultivation of drilled turnips, the enlargement of the size of farms, and the general opulence and intelligence of the tenantry, who occupy any considerable extent of light dry soils. It is at least certain, that, without this crop, all the different branches of husbandry cannot be combined, as they often now are, under the direction of one farmer;—the breeding, rearing, and fattening of sheep and cattle, with the most correct cultiva-

tion of every species of white crop, and the most beneficial mode of converting the straw of these crops into valuable manure, and the application of it to the soil with the greatest effect, and under the most favourable circumstances.\*

In discussing this subject, it is proposed briefly to consider the following particulars: 1. The process of drilling; 2. The different sorts of turnips cultivated in Scotland; 3. The produce of each sort; 4. The manner of consuming them; 5. The mode of preserving them; and, lastly, Any miscellaneous particulars which may be entitled to notice.

1. The process of drilling turnips, is very ably described in the Berwickshire Report, and in other publications,† and the annexed plan, taken from that Report, will give a general idea of the system.

It is not proposed, in this work, to enter into all the *minutiae*, of the culture of drilled turnips, which it would be difficult to imitate from description merely. It would be advisable, indeed, for those who wish to try the plan, to procure a person, experienced in the process, to conduct it; it may otherwise fail, owing to want of attention to some minute particular, which may be of more importance than is commonly imagined. The annexed plate, and the subjoined explanation, will give a general idea of a system, which cannot be too strongly recommended to the attention of those, who may wish to introduce the culture of turnips, on the most improved system, in other districts.

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\* Farmer's Magazine, June, 1812, p. 239.

† In the year 1797, Mr Alexander Low of Woodend, in particular, drew up, with great clearness and ability, for the late Duke of Bedford, a short account of the Berwickshire mode of turnip culture, as then practised.

*Explanation of the Plate.*

FIG. 1. is a section of the drills, as first formed, and having the muck or dung spread out in the hollow drills, with a line pointing out where the ridglets are afterwards split.

FIG. 2. represents these drills, as split open, to cover the muck; what was formerly the hollow drills, is converted, by this operation, into the ridglets, and *vice versa*.

FIG. 3. Gives an idea of the figure of the drills or ridglets, after having been rolled by the drill-machine at the time of sowing the seed. The seed cannot be sown too soon after the land is thus prepared for its reception.

FIG. 4. is a representation of the appearance of the field, after the earth has been gathered into the intervals between the turnip drills, as formerly practised, but which has now given way to the use of the horse-hoe.

FIG. 5. shews the situation of the drills, on finishing off the field, in the older method, by splitting open the gathered ridglets in Fig. 4., but which practice is not now generally followed.

FIG. 6. gives an idea of the situation of a field of drilled turnips, as now generally finished off; the furrows or hollow drills not being opened out, the shaws or tops of the plants being removed for the use of the young stock, previously to the feeding flock being laid on.

FIG. 7. gives a plan upon a smaller scale than the preceding sections, of a turnip field in regular drills, in which the drills are laid off obliquely to the usual direction of the ridges, to facilitate the more equal distribution of the muck, which had been covered up in the drills, when afterwards ploughed for a grain crop.

2. The sorts commonly cultivated in Scotland, are known under the name of the Common Globe Turnip, the Yellow

Turnip, and the Swedes;\* the Tankard and White Norfolk have also been successfully raised for early consumption by sheep. The Globes, and the Swedes, however, are the most prevailing varieties. The latter may be managed entirely like common turnips, but they require more manure, and stronger land, perhaps with a little clay in it. They should be *sown* about the middle of May, under the drill system.

Some experiments have been tried by Mr Blaikie, a native of Roxburghshire, who is now bailiff to the Earl of Chesterfield, with the three first sorts. The globe turnip produced the largest crop, but was the most tender; the yellow proved a fine crop, was more nutritious than the globe, and stood the winter better; the Swedish turnips maintained their superiority for hardiness; and the yellow Scotch was next, in regard to that very essential quality.

The yellow Scotch field turnip, to a certain extent, may be considered as a valuable acquisition, for the following reasons:—1. It is more hardy than the globe, tankard, red top, green top, or any variety of the Norfolk turnip.—2. It does not draw more nourishment from the ground than any of those varieties, consequently does not require that any extra preparation should be made for it.—3. It is not so hardy as the Swedish, but has the advantage, in not requiring so much manure; does not exhaust the ground so much, nor does it require to be sown so early by a month: this gives time for cleaning and preparing the fallows, which are too often but imperfectly cleaned when the

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\* I am informed that the Swedes were first introduced into Scotland *anno* 1781-2, on the recommendation of Mr Knox, a native of East Lothian, who had settled at Gottenburgh, whence he sent some of the seeds to Dr Hamilton.

Swedish are sown.—4. The yellow Scotch is also a good table vegetable, being palatable, more nutritious, and not so watery as the Norfolk varieties.

When Swedish, yellow Scotch, and Norfolk turnips, were strewed indiscriminately over a field, and cattle and sheep turned to them, it was observed that the stock selected the yellow Scotch, after being used to them. This, however, depends much upon the particular period of the season when the trial is made.

It is also maintained, though not ascertained by decisive experiments, that the yellow is by far the best turnips for milch cows, and that they thrive much better than the Swedes in light soils.

Mr Walker of Mellendean finds that the Scotch yellow turnip, stands the frost as well as the Swedish, and he thinks that horses prefer them to any other. If they are found to stand the variations of the weather in spring, equally with the Swedish, they appear to him to deserve the preference in other respects.

Mr Culley finds, that neither the yellow, nor any other turnip, the Swedish excepted, will retain its juices in the spring, and he considers the Swedish, on that account, as entitled to a decided preference. Mr Rennie of Phantassie also considers them, as, without exception, the most useful plant of the whole species, and without them, there is no safety or security, either for feeding or breeding stock. He recommends, therefore, that one-third of this species, in so far as turnips are cultivated, should be sown on every farm. The only objections to them are, their being of so hard a nature, as to be very pernicious to the teeth of stock, particularly the very young, when shedding their teeth, or the very old; and that they require rich land, or a great deal of manure. They may be transplanted, but

in that case do not come to the same size, as those which grow upon the spot where they were originally raised.

Mr Gray of Gorgiemuir, near Edinburgh, finds Swedish turnips more profitable on his clayey soils, than beans or yams, and he gets them off without poaching the land, though of a wet description, by the following method. When he can spare hands, and the weather will permit, the turnips are pulled, the roots cleaned, and laid in heaps with the tops on, all lying one way. When frost comes that will bear the carts, he sends the turnips, in this state, to the cowfeeders in Edinburgh, and sells them readily at a shilling *per* cwt. when common turnips will only fetch ninepence *per* cwt. The portion proposed to be kept for the horses till spring, are brought home, and stored up in any spare corner, after the tops are cut off, which are given to the cows. Mr John Shirreff recommends it as a more advantageous plan, to draw and store the whole, when they could be disposed of at convenience.

Mr Aitchison of Clement's Wells commonly sows about 30 acres of turnips yearly, of which, from 15 to 20 acres consist of the Swedish sort. These serve his cattle and sheep till the grass gives a good bite. If his sheep are young, he cuts the turnips for them with a machine. He adds, that in his opinion, a greater quantity of good food for stock, is got from the two sorts of turnips, and at less expence, than what is procured from any other article he has ever tried. Mr Kerr observes, that the Swedish turnip is perhaps the best winter vegetable we have except the potatoe. Five pounds weight of beef or mutton will make richer Scotch broth, along with Swedish turnips, than seven pounds along with an equal quantity of any other turnips. It is fully equal to a mixture of carrots and turnips in that respect, and much sweeter.

A new plant of the turnip sort has been lately introduced into Scotland, called noll-kholl. It rises like a cabbage plant till it is about three inches high, then forms like a Swedish turnip, and appears to be much of the nature with that useful plant. They were first raised in East Lothian by Mr Alexander Johnston, surgeon in Dunbar, who some years ago received a few seeds from General Sir David Baird, on his return from the Cape of Good Hope. I have seen them in great perfection at Lord Lauderdale's, near Dunbar. A correspondent informs me, that they are cultivated in Strathearn, and that the sheep preferred them much to turnips.

3. The produce of the turnip crop necessarily varies. Mr Paterson of Castle-Huntly found that his globe or common turnip weighed fifty tons *per* Scotch, or forty *per* English acre, when entire, but only forty-six tons when the tops and tails were cut off. Mr Allan of Craigrook states, that on his farm at Oldliston, the common white turnip weighed from forty to fifty tons *per* Scotch acre. The Swedish turnips also, when properly cultivated, produce a heavy crop. I am informed, from undoubted authority, that a Scotch acre of that sort, in East Lothian, weighed no less than forty-four tons, which is at the rate of about thirty-seven tons *per* English acre. The crop appeared so great, that several respectable farmers in the neighbourhood attended to see it weighed.

In regard to the weight of turnips on the different soils, Mr Rennie of Phantassie states, that in the best land, worth L. 5 *per* Scotch acre, the produce may be forty tons, which is at the rate of about thirty-two tons *per* English acre. Where the land is of inferior quality, the produce must necessarily be less. The profit to be derived from such a crop, must depend upon various circumstances; the value is generally calculated at 5s. *per* ton to the

grower, when sold on the ground, but the person who buys them ought to have a profit of from 1s. to 2s. *per* ton, to indemnify him for his outlay on the stock fed, and his risk, labour, &c. In regard to the question, whether it is most profitable to feed sheep or cattle with them, that must depend upon soil, situation, markets, &c. Sheep are generally preferred on dry soils, and in good situations, but cattle in the colder and higher climates.\*

4. The mode of consuming turnips, by feeding cattle and sheep, is well known; but there is one mode of giving them to sheep, adopted by Mr Hunter of Tynfield, in East Lothian, which seems to merit particular attention.

He states, that he has been in use, for several years past, to convert part of his straw into manure in winter, by folding sheep, and giving them turnip on the top of the straw. In 1808, he had 300 sheep, mostly black-faced wedders, three years old, from the Highlands, at L.20 *per* score, fed on turnip in the following manner: A fold, containing an English acre, was made in the corner of a field on a southern exposure, sheltered from the north and west by a strong thorn-hedge: the whole fold was then covered with straw a foot thick. The sheep were turned in, and turnips carted and laid on half of the fold upon the straw, and a daily supply was continued on the same half till the straw under them was a little wet: the turnip was then laid on the other half, covering that part where the turnip had been first laid with fresh straw, and he continued to change, from side to side, once in two or three

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\* Mr Curwen states, that an acre of turnips will feed sixteen sheep for six months, or a hundred and eighty days, allowing 28 lb. to each sheep *per* day, and 4 lb. for waste of tops, &c. This gives some little more than 41 tons *per* acre. Mr Logan lets his turnips at 6d. *per* week, and made L.9 of them *per* acre. This gives 38 tons.

days, always giving fresh straw the whole season. The sheep lay very dry, the straw serving as a drain to receive moisture. As the *palm* or chaff upon the straw was eaten by the sheep, they fattened apace, and were sold in March at L. 42 *per* score. The quantity of manure produced was very great, (no doubt partly depending on the quantity of straw used), in one year not less than 800 tons of the best manure he ever saw on his farm. The particulars of this important experiment, and other interesting particulars therewith connected, will be given in the Appendix, No. XII.

It has been objected to this plan, that there can be no difficulty in converting straw into dung, in the common way, by giving turnip to cattle in straw yards;—but there may be reasons for preferring sheep. Another objection is, that this mode of consuming turnips, is inconsistent with one great object of the turnip husbandry, that of consolidating the soil, and at the same time, destroying annual weeds, by the treading of sheep;—but where, from the lightness of the soil, treading is absolutely necessary, only one-half of the turnips may be drawn.

Another correspondent informs me, that for some years, he has adopted a similar practice of feeding sheep, by keeping them confined in a standing fold during the winter months, and giving them turnips thrice a-day upon the straw. It requires, however, a considerable quantity of straw, as they must always get some every second or third day, and in wet weather every day: but it is certainly an excellent method of making manure, where there is plenty of straw.

Several farmers have of late years grown *ruta бага*, or Swedish turnips, for the use of the horses and other stock, during that critical period when the common turnips fail, and grass has not yet become abundant, and for these purposes this esculent is invaluable. But Mr Church of Hitchill

observes, that where the soil is thin and dry, it is impossible to raise a good crop of Swedes under any management. He therefore begins to entertain an idea of substituting potatoes in their room.\*

5. It is well known, that when milch cows are fed on turnips, the butter has an unpleasant taste : but this may be remedied in various ways. 1. By carefully picking out all the putrid turnips and leaves, and giving the cows nothing but clean bulbs or balls : the turnip taste is by this means hardly discernible. 2. By giving the cows, Swedes, or ruta бага, which is better for them, gives the butter a superior colour, and less taste of the vegetable ; and, 3. By putting one ounce of saltpetre into a teapot, and pouring upon it an English pint of boiling water : when melted and cold, pour what may be necessary among the milk when warm from the cow, in proportion to the quantity of turnips the cow has eaten. The quantity necessary can be easily ascertained, by tasting the milk after it is mixed with the saltpetre. The milk, the cream, and the butter, are thus rendered perfectly sweet. Others recommend putting about one ounce of saltpetre into an English gallon of cream, before churning.

Mr Blair of Montague, near Perth, on the first appearance of severe frost, has been accustomed, for thirty years

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\* Mr Kerr observes, that potatoes are now very extensively applied to the use of cattle and horses in Lanarkshire. If this is ultimately found to answer, and the practice become universal, it will secure the country against the possibility of famine, in the very worst of years. It will become a source of tangible human food, usually applied to animals, who may be supplied from other sources calculated for their subsistence. In a year of dearth, the high price of potatoes will naturally induce the farmers to stint their cattle, for the supply of the people, and to replenish their own pockets.

past, to store up turnips, cutting off their tops and tails, and thus preserving them sound and good for three months, much to the advantage of his farm: and the cowfeeders near Edinburgh have long followed the same practice. Mr John Shirreff received thirty guineas from the Society of Arts, for communicating to that public-spirited institution, a simple mode of drawing and stacking, either the whole, or the greatest part of his turnip crop, for several years in autumn, intended to be consumed during the following winter and spring, a practice which he found attended with much convenience, economy, and emolument.\*

The celebrated George Culley has communicated to me a fact, which, though perhaps known to many intelligent farmers, may not be so universally propagated as it deserves to be. It is this, That all *crude soils*, or even such soils as have been cultivated, but which have had little or no calcareous matter mixed with them, will produce better turnips, with a plentiful application of lime or shell marle only, without any dung whatever, than with dung, without any lime or other calcareous substance. This he finds from long and repeated experience.

In cultivating Swedes, it is recommended to sow them in a garden, or sheltered spot, in the end of April, or beginning of May, and to plant them out, as they become large enough, upon ridges 27 inches apart, with the dung immediately under them, as commonly practised. The roots of the plants, when put in the drills, should be put in a tub of water, well impregnated with dung. There is every reason to believe, that a good crop may thus be obtained; and it

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\* This useful communication is printed in the 22d volume of the Transactions of the Society of Arts, p. 118. This experiment took place *anno* 1803.

is contended by an experienced farmer, that transplanting is cheaper than sowing the seeds in the drills, and that any given weight of turnips will cost the farmer less. By this mode also, all injury from the fly is prevented.

Mr Carnegie of Hailes, in East Lothian, is endeavouring to raise a new variety of turnip, (mules between the ruta-baga and the large white Norfolk turnip), which he expects will be of great value to the agriculturist, being much larger than the Swedish turnips, and possessing much of their nutritive quality and durability in adverse seasons. He hopes soon to be enabled to try them on a large scale, and he is inclined to think, that they are not unlikely to supersede the use of the common turnip altogether. It would be a material object, if this sort would bear transplantation, as well as the real Swedes.

It is said that the turnips in Berwickshire are seldom injured by the fly. This may perhaps be attributed to the superior culture for which that district is so much distinguished, by means of which, the young plants are enabled, to push away at the beginning, with more vigour, than when the management is less perfect; for it is a general observation, that the more rapid the vegetation of the plant, the better is it able to withstand the effect of the insects' depredations. The Berwickshire and Roxburghshire farmers, have a great advantage in the culture of their turnips, from the freshness in which their lands are preserved, by the system of two years' grass in their rotation.

It has been remarked in Banffshire, that mixing earth or moss with the offals of fish, makes an excellent compost, particularly for turnips, and that the best turnips are always after fish dung. This should be attended to on the sea-coast, where such quantities of fish, and of fish offal, may be had.

The late Mr Barclay of Ury, whose authority as an

agriculturist ranks so high, always dunged for *turnips in the preceding year*; that is, the turnip was the second crop after the dung, the muck in this case being completely incorporated with the soil, before the seed is sown. This practice has been followed by some farmers in the Mearns, and it is said with success. Mr Kerr, however, on this head remarks, that this plan, though frequently tried, has never answered in Berwickshire, where *recent dunging* is found, by experience, quite necessary to ensure a good crop of turnips. He knew a farmer who lost his turnip crop, in a great measure by dunging before winter, to save spring labour.

Though the process of drilling turnips in Scotland is well known, it would be a great object gained to the farmer, if some means could be devised, for making them vegetate equally in a dry season. The seed is sometimes steeped, to make it spring readily, and even the drills watered after the seed is deposited; all these are known and occasionally practised in Scotland. But by the following accident last summer, Mr Church of Hitchill has been led to conclude, that sowing the seed on the moist dung, as spread in the drills, would secure a certain and regular vegetation, and afterwards ploughing down the dung in the usual manner, but perhaps not covering it quite so deep, would be a practice well worth adopting in a dry season. Mr Church having prepared his ground for sowing Swedish turnips, some seeds of the globe turnip were deposited by accident on the dung spread for the Swedish, before it was ploughed in, which was sown in the usual manner. On the same day, about an acre of the globe turnip was sown on land of the same quality, and dunged in the same way. From the dryness of the season, neither the Swedish nor the globe turnips vegetated till a month after sowing, and these crops turned out moderate. But the seed which had accidentally

fallen on the dung, as above stated, vegetated rapidly, and the turnips attained a great size, indeed they could not get larger for want of room in the drills; many of them weighed from 15 to 28 lbs. with tops and tails. This practice may prove highly useful in dry seasons, and indeed should always be tried, as the expence of the seed is but trifling. The great difficulty will be, to lay the soil sufficiently thin and regular over the small seeds.

Mr Church made a second trial, which was attended with all the success he could reasonably expect. The turnips were fully larger than those sown in the ordinary way, and vegetated as soon as when seed is sown in rainy weather. When the turnip seed is sown upon moist dung, he finds, that the slightest covering of earth is sufficient. It is well known, that it is the steam or effluvia evaporating from dung placed in a drill, which makes drilled turnips vegetate more rapidly than the broad-cast. This gives the drill a decided preference over the broad-cast, independent of other considerations; and it would appear, that the more immediately the steam or effluvia can be applied to the seed, the more likely is the crop to be productive. A difficulty might however arise in setting out the young plants, as having a small hold of the ground, they would be easily torn out by the stroke of the hoe when the thinning process was executed.

In a more recent communication, (16th July, 1813), Mr Church informs me, that a neighbour of his tried the experiment last year, in contrast with the common way. The crop sown on the dung, not only came away quicker at first, but was ultimately a much heavier crop. He deposited the seed by hand on the dung; but a simple drill, without a coulter, and only one wheel, would be the most convenient for placing the seed on the dung, and could easily be pushed along by a man, without the assistance of

a horse. A gentleman obtained good turnips in this way, and by husbanding the dung, in a singular manner, for the purpose of making it go over more ground, than could easily be accomplished in the usual way. Dung was put out of the cart, at equal distances, in heaps, which women lifted into small hand baskets, and going along the drills, laid pieces of dung, at equal distances by hand, at the bottom of the drills, say at from eight to ten inches apart, (the distance at which the turnips were intended to be left when hoed); a person then followed, and dropped a few seeds on each of these small pieces of dung, which was afterwards covered by a light furrow. This method may furnish a useful hint to small farmers, though it may be thought tedious to be attempted on a great scale.

On the whole, there is certainly no branch of husbandry more desirable to bring to perfection, than the culture of turnips. The common sorts can be sown with advantage, from the 10th to the end of June, giving the farmer ample time to clean his ground. It is, besides, a fact well known, that the close deep shade of the turnip leaves, has a tendency to rot all below them. There is perhaps no article that produces, at so cheap a rate, such a quantity of food for stock, or that is the means of raising so much valuable manure. Experiments, however, are still wanting, regarding the culture of this root, before it can be brought to perfection; in particular, it would be necessary to ascertain, the specific weights of each sort *per acre*; the quantities of beef and mutton produced by equal weights of each sort of root; the quantities of manure required for each sort; and the effects of each, on the following crops in the rotation.

8. *Potatoes*.—The culture of potatoes has greatly increased in Scotland, owing to the following circumstances:

1. The excellent mode in which they are raised; 2. The demand for them at market; 3. Their proving so valuable a preparation for crops of wheat; and, 4. The custom adopted by farmers, of giving portions of land for raising potatoes, both to their own servants, and to the inhabitants of any neighbouring town or village.

1. Nothing can be superior to the mode of raising potatoes by the plough, and in drills. The following account of that process, though peculiarly applicable to the neighbourhood of Glasgow, does not vary materially, from the practice usually adopted in other parts of the kingdom.

The ground is prepared for a potatoe crop by ploughing in winter, or rather in autumn; and to keep it dry, during winter, the ridges are gathered, and the furrows kept clear. It is sometimes ploughed once, and sometimes twice, and well harrowed during the spring, and the drills being formed, the dung and cuttings are put in, and covered with the plough. In sandy ground the cuttings are put below, and in heavy soil above the dung. The potatoes are dressed in summer in the ordinary way, the drills being pared or sliced, horse-hoed, hand-hoed, weeded, &c. as in other parts of the country.

In regard to the produce and value, that must vary according to the condition of the ground, the time and manner of culture and cropping, the season, and other relative circumstances. A potatoe crop will average from 40 to 50 bolls *per* acre. They will sometimes fall short of 40, but many have reaped more than 60 bolls from one acre. General Spence sold last year a potatoe crop, for part of which he was paid L.29 *per* acre, and potatoes were raised from part of the field, at the rate of 80 bolls *per* acre. Andrew Moodie, Esq. reaped, for a first crop, upon deep moss, near Paisley, from 17½ acres, near one acre of which was occupied with roads, ditches, &c. 774 bolls of potatoes,

which he sold at L. 418 : 6 : 2. Robert Cameron, in East Walkingshaw, near Paisley, raised 60 bolls *per acre*, from moss-ground. Potatoes are usually sold at from L. 18 to L. 28 *per Scotch*, or L. 24 : 7 : 8 *per English acre*, the purchaser digging up and removing the crop. In a field, near Elderslee-house, potatoes, planted without dung, after a crop of oats, from old pasture, to which no manure had been given, sold at L. 27 *per Scotch acre*.

Mr Andrew of Tillilumb, near Perth, adopts the following plan in the cultivation of potatoes: 1. He cross-ploughs; 2. Puts in the dung; 3. Ploughs a second time; and, 4. The ground is either drilled for potatoes, or another ploughing given, and the potatoes planted after the plough in every third furrow. He usually follows the last mode, as he thinks it best calculated to do justice to the ground, and generally brings a good crop. Repeated ploughings after the manure is applied, cannot however be recommended. The expences, besides rent and dung, may be stated as follows:

Seed <i>per acre</i> , 2½ bolls, (32 stone Amsterdam, 17½ lbs.) at 12s. <i>per boll</i> ,	-	-	-	-	L. 1 10 0
Cutting the seed,	-	-	-	-	0 2 6
Planting,	-	-	-	-	0 4 0
Cleaning, after being horse-hoed,	-	-	-	-	0 12 0
					L. 2 8 6

Potatoes at Perth sold this year at about L. 15 or 15 guineas *per Scotch acre*; and if L. 5 is supposed for rent, and L. 5 for dung, it will appear that there is not too much profit for so much labour, and that the chief profit lies, in the state of preparation the ground is brought into, for the

succeeding crop. In a wet season, potatoes do not answer upon heavy land.\*

The average produce of potatoes near Edinburgh, is from 40 to 60 bolls *per* Scotch acre, and the value from L. 20 to L. 30, average L. 25.

2. The consumption of potatoes is annually increasing in Scotland, every prejudice against the wholesomeness of that root having been long ago exploded. The simple modes in which they can be prepared for the table, is of the utmost advantage to the poor; and by the addition of salted herring, both the taste, and the nourishment afforded by that useful article, may be improved. It is difficult to conceive, how the people of this country could have subsisted, had it not been for the fortunate introduction, and extensive culture, of this most valuable plant. Indeed, the same numbers could not have been maintained.

3. Potatoes are found an excellent preparation for crops of wheat. The frequent ploughings necessary for raising that article; the quantity of dung allotted for it; the fre-

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\* The following is the expence of cultivating one acre of potatoes near Dalkeith:

Dung, 40 single-horse carts, at 5s.	-	-	-	L. 10	0	0
Three ploughings and harrowings,	-	-	-	2	0	0
Seed, cleaning with horse and hand-hoe,	-	-	-	3	10	0
Taking up and housing,	-	-	-	2	10	0
Rent,	-	-	-	5	5	0
				<hr/>		
				L. 23	5	0

Hence, at the average value of the produce near Edinburgh, (L. 25), the profit is trifling, and there must sometimes be a loss. But Mr John Shirreff remarks, that they save the expence of preparing the *three* following crops in the rotation, and thence the profit arises.

quent hoeings, the stirring which the ground receives when they are gathered, (sometimes perhaps more than is necessary), and the favourable period of the year when they are taken up, are excellent preparations for the culture of that important grain. Wheat after potatoes, therefore, is almost universal, wherever both are cultivated on an extensive scale. But this plan can only be followed near great towns, where alone potatoes can be used in great quantities, and sufficient muck purchased to raise them. In those parts of Berwickshire, Roxburghshire, and East Lothian, at a distance from town manure, potatoes are not approved of as a preparation for wheat, farmers considering them as little better than a nursery for weeds, and on that account they are often planted upon clover leys, that the whole may be cleaned by fallow or turnips, the ensuing season. It is very difficult to raise a clean crop after potatoes, as they must be planted too early for spring cleaning, (unless a scuffler is repeatedly made use of), and they must be earthed up too early for summer cleaning. From the time of earthing up in July, the root-weeds cannot be disturbed, but retain full possession of the ground, for at least two months of the most *growing* part of the summer. There are some fields near Edinburgh, which, in consequence of these circumstances, contain a shameful abundance of weeds after potatoes, even where no dung has been given to the land, either with the potatoes or the wheat.

4. The culture of potatoes, is very much increased by two practices: 1. That of farmers giving a certain portion of land for raising potatoes to their servants; and, 2. By a practice of farmers in the neighbourhood of towns and villages letting land to the inhabitants for the same purpose, they furnishing both dung and labour, at least in so far as regards the cleaning processes. Near Cullen, in Banffshire, they get a fall of ground for a load of dung, which

the farmer puts on his turnip field, as the people consider the potatoes of a better quality, when raised without dung. Mr Stewart of Hillside, by letting an acre for potatoes, gets one day's labour of 120 reapers.\* They give the seed only, and take up the crop. The land is let to labourers and tradesmen in a neighbouring village. The value of the potatoes is above the ordinary wages, and the reapers besides receive maintenance when they are employed; but it is a great advantage to have a number of labourers at command, more especially during a critical harvest.

The culture of potatoes, is likely to be materially increased by the following circumstance. Mr Spears of Dysart informs me, that within these three or four years past, the farmers occupying a dry loamy soil, in place of raising only turnips for feeding, now raise nearly half potatoes,† and half turnips. In this way they find, that by giving their cattle as many potatoes as they can eat, the one half of the day, and turnips the other half, they become fat, in little more than half the time requisite to feed them with turnips alone. They likewise find, that an acre of potatoes, will go farther in feeding than an acre of turnips, with this great additional advantage, that no weather can affect the feeding of the cattle, when they have potatoes always at com-

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\* An acre of potatoes gives 120 days reaping, (*shearing*), at 55 yards for each day, the drill being 34 inches wide. The acre thus pays L. 9, the reaper furnishing seed; the wages, reckoned at 1s. 6d. besides victuals, which together make 2 s. 2 d. *per* day. The reaper (*shearer*) has his potatoes at nearly 20 s. *per* ton, often much less: the advantage of the farmer is, having these reapers at his call, and only on the days when required.

† It is a pity, that these farmers do not get the Patagonian, or bullock potatoe, from Mr Church of Hitchill, in Dumfries-shire.

mand; whereas formerly, during severe storms, the turnips were often so much hurt by the frost, as to do the cattle no good, while it continued. They are also thus enabled to keep them on much longer in the spring, as potatoes may be used two months after common turnips are quite useless, though this argument does not apply to the Swedes. This plan seems to be gaining ground, and is likely to answer in the western districts, where they prefer the culture of potatoes to that of turnips. By turnips, an ox may be fattened in five months. By this new mode of feeding alternately with turnips and potatoes, three months, or even less, may be sufficient, the cattle being probably tempted to eat more from a change of food. It is not likely, however, that an acre of potatoes will go farther than an acre of even common turnips. The same land that will produce 12 or 13 tons of potatoes,\* would yield 40 tons of turnips. It is probable the latter would go farther in point of fattening, and at any rate would produce the most manure. It is a most important circumstance, at the same time, in favour of potatoes, that when they are produced, they can easily be converted, if necessary, from the food of stock, to that of man, and consequently, in times of scarcity, would prove an invaluable resource. They do not require also, such strong land as the Swedes.

9. *Clover and Rye-grass.*—Red clover, with a mixture of rye-grass, and occasionally with some white and yellow clover, and perhaps rib-grass, are the grasses almost universally sown in Scotland. Some experiments have been

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\* Mr John Shirreff is convinced, that from the first of October, till Christmas, raw turnips will feed faster than raw potatoes.

tried with lucern,† sainfoin, chicory, &c. but not to an extent entitled to any particular notice.

The introduction of red clover, was one of the most fortunate circumstances that could have happened to the husbandry of Scotland, more especially since the mode of cutting it green for stock, or soiling, has been adopted; the produce is immense, whilst from the size of its root, which remains in the ground, it does not exhaust, as otherwise would be the case. It is also an excellent preparation for other crops. It is said, that land soon grows tired of clover, but, where that is the case, to any extent, it is to be attributed to the want of deep ploughing, one of the principal advantages attending summer-fallow. Clover delights in new soil, in so much, that when it is at first tried, in any ground tolerably fertile, the produce is hardly to be credited.

The propriety of cultivating rye-grass, is an important subject of discussion. It is certain, that many English

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† Two experiments have been reported to me of the culture of lucern in Scotland; one by a proprietor near Edinburgh, who has about three acres of this plant, with which he maintains ten or twelve horses during the summer season; the other is by Mr Duffin, vinegar merchant at the Abbey. He has had it for several years growing in a plot of his garden; the plot is not near a rood, and it maintains one horse to him during the summer months: he has three luxuriant cuttings, and an after-cutting in the end of autumn. From the first sowing it grows annually; it lasts from ten to fourteen years, yielding good crops, and perhaps may remain in vigour much longer. He has tried transplantation, and it answers to his wish, for lucern throws out a number of fresh shoots from its root. It requires to be hoed clean from any other grass or weeds. There cannot be a doubt of its thriving well in Scotland, in rich deep soils, which it requires, as its shoots go far into the ground; hence a tilly or rocky bottom is improper for it.

farmers, who are eminent in their business, abhor rye-grass on strong lands, from a multitude of observations on the wheat which follows it; for the cases are many, in which fields, partly sown with clover alone, and partly with clover and rye-grass, where the superiority of the wheat after the clover alone, induced them to resolve on the omission of rye-grass in future. Mr Rennie of Phantassie concurs in that opinion. He observes, there can be little doubt that rye-grass is very hurtful to wheat, and when wheat is intended, no rye-grass ought to be sown. But wheat after grass, or even after clover alone, being now almost totally given up, oats paying better, the observation does not apply to the system of husbandry practised in Scotland.

It has been alleged, that cocksfoot answers all the purposes of rye-grass, particularly as a mixture with clover; that it supports more stock, and does not equally exhaust the soil;\* but this is a circumstance not yet fully ascertained, and rye-grass, if properly cultivated, is certainly a valuable plant, either sown by itself, or mixed with clover. In regard to rye-grass, either cut green, or converted into hay, a person of much experience in the management of horses, (Mr Alexander Maclaurin of Edinburgh), considers rye-grass, mixed with clover, as a strong, pleasant, and substantial food for horses, even at hard work, and every season he has given it green, even to post-horses, in the stable, and it has answered well. He is also of opinion, that hay made of clover and rye-grass, if cut at a proper season, (before the plants are too ripe), if safely got in, and properly thatched, so as to prevent its being injured by the winter rains, instead of becoming dry and husky, as some people

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\* All difference between cocksfoot and rye-grass, must depend on the weight of the crops, and quantity of seed carried by each.

imagine, improves by time, and is much fitter for the use and benefit of horses, than if used some months before, and indeed will retain this perfection, all the ensuing summer, autumn, and next winter ; on the supposition, always, that it is preserved from rain. Good old hay, for that reason, always gives a higher price than new. In a comparative view of rye-grass mixed with clover, and meadow-hay, the former is to be accounted much preferable to the other, on account of its strength and substance, by which horses are enabled the better to stand hard work. The fibres of meadow-hay are soft and small, and according to Mr Maclaurin's opinion, dissolve sooner in a horse's stomach, consequently, not so proper for hard-working horses as the other. Mr John Shirreff remarks, that every cultivated vegetable, is more nutritious, than a natural and wild one of the same sort. The hay of a natural meadow, cannot possibly be obtained, in a state equally perfect as that of cultivated herbage, because, being composed of many plants, some of which are faded, some too young, some wiry and run to seed, and some fresh and in flower, they cannot assimilate into a homogeneous fragrant mass, so readily as the other. Clover hay, therefore, always sells higher than natural meadow-hay, whether low or upland.

Mr Robertson of Ladykirk states, that from long experience, they find, in Berwickshire, perennial rye-grass to be peculiarly valuable. It is the earliest and latest grass they have, but it should *be fed close*, and not allowed to go to seed, otherwise it will exhaust the land.\* Mr Andrew of Tillilumb observes, that he has never found a mixture of rye-grass among clover prejudicial to the ground, pro-

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\* Mr John Shirreff is of opinion, that annual rye-grass is more relished by stock, and carries a heavier crop.

vided it was cut in due time, just when the bloom is falling from the rye-grass ; but, if allowed to ripen, he believes it may be nearly as exhausting as a crop of grain. In short, clover and rye-grass hay, if cut in due time, is a most nourishing and wholesome food, either for cattle or horses, and will keep good for several years, if properly stacked and thatched.

• In regard to the value of clover and rye-grass, even at a distance from large towns, Dr Young, near Stonehaven, informs me, that the common price, when sold in very small villages to cowfeeders, is from L. 10 to L. 12 *per* Scotch acre, when milk is sold at 2½ d. *per* Scotch pint.

The cultivation of artificial grasses in Scotland, is already so generally known, and will be so fully detailed, in the General Report now drawing up, of the Husbandry of Scotland, that it does not seem necessary to dwell upon it longer in this place. It is only necessary to add a maxim regarding the culture of clover and rye-grass, that ought never to be deviated from, namely, that they should never be sown, but when the land is in the very best condition, and, if possible, with the crop immediately after a summer-fallow or after turnips.

10. *Miscellaneous Articles.*—It is evident, that in various parts of an extensive kingdom, a number of articles must be cultivated, to a small or a moderate extent, which do not form a part of the general husbandry of a country. In Scotland, the most important of these are, carrots, cabbages, kale, rye, and flax.

*Carrots.*—This species of crop, is not so much cultivated in Scotland as it ought to be. Its culture seems to be attended with no more difficulty than that of cabbage, potatoes, or turnips, and if properly managed, with little, or

perhaps no more expence. An active improver, (Mr Alexander Guthrie), states, that in his attempts to raise the carrot, with hardly any exception, he has succeeded beyond expectation. For working-horses, he knows no food equal to carrot, and of this he has had complete experience. Were the growth of carrots general over the country, and used as food for working-horses, he is of opinion, that two-thirds of the oats consumed for that purpose might be saved. In years of scarcity, this would be of great advantage to the nation, and a blessing to the poor.

Mr Butterworth, who rented some land near Edinburgh, to carry on the cultivation of carrots, informs me, that he tried that root for seven years, upon the same ground, without dunging, and with great success, and he had one year twenty acres, which he sold at 5 *d.* per stone, and two acres and a half, for L. 60 sterling, without being at the expence of drawing them. He ploughed the ground in October,\* in the common and ordinary way; in March he ploughed it again in the same manner, and harrowed it well, and where it was sheltered, he sowed the seed immediately after the harrowing, that the weeds might not get a start of the seed, which is of great consequence. The drills† were made at one foot asunder. He then rolled the ground with a heavy roller, drawn by two horses; when the rows appeared, he run the Dutch hoe betwixt the rows, and hand-weeded the rows, leaving the plants four inches asunder; in about three weeks after, he weeded a second time, and kept them very clean. In October, he cut off the tops with a scythe, and raised the carrots by ploughing the ground in the ordinary way, as many as were required; but where

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\* In other parts of the kingdom, autumnal ploughing is found much to increase weeds, and to add to the expence of hoeing.

† Drilling has been tried in Suffolk, but did not succeed.

the ground was dry, he let them remain with their tops on, to guard them from the frost, and raised them as he had occasion: frost destroys them, if left in wet ground, during the winter; but in dry ground they keep best till the spring, when they begin to grow, and should be raised in March. Mr Butterworth sowed about 7 lb. of seed \* *per* Scotch acre; they yielded a profit equal to wheat, and improved the soil, till he had the best crops of barley and wheat after, that could be imagined; the ground was very indifferent, before it was improved by the cultivation of carrots. He sold the spot, which was at Burnhead and Stonehouse, near Liberton, twelve years ago, at more than double the price paid for it, without any improvement, except by cultivating it with carrots. On an average, the produce was about 2200 stones, or  $13\frac{3}{4}$  tons *per* Scotch acre. Where the ground was cold, and not sheltered, the ground was not sown till April.

Mr Guthrie states, that in the attempts he made to steep the seed, he partly succeeded, and partly failed, the seed being bad; it was steeped in pure water twenty-four hours. † He has tried to transplant carrots, but did not find it to answer. He does not think it a good plan to cut off the tops, the second growth coming too late to protect the carrots from the frost, as he allowed them to remain in the ground during the winter. He has given them to his horses during the whole of April, quite sound and fresh, and they eat the tops as well as the root.

Mr Paterson of Castle-Huntly also cultivates carrots. He cuts the tops as required, and gives them to the cows;

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\* Never more than 5 lbs. of seed sown in Suffolk broad-cast by the best farmers; the seed being good, that is to say, new. This is nearly the same as 7 lbs. *per* Scotch acre.

† In Suffolk, this is reckoned a most important part of the system.

the produce of one acre of which, served to support nine milch-cows for a fortnight; after which the carrots were taken up with the plough; the remainder of the tops were cut quite close to the body before housing.

Mr John Shirreff has made an interesting experiment, on a small scale, to ascertain, whether carrots are deteriorated, or otherwise, by cutting off their tops in summer, and converting them into hay.

Weight of the roots of the carrots, grown on a small piece of ground, drawn and weighed on the 30th		lb.	oz.
November, 1810,	- - -	16	4
Ditto of the leaves,	- - -	8	0
		<hr/>	
		24	4
Ditto of the leaves cut on the 7th of August,		7	8
		<hr/>	
	Total,	31	12
Weight of the roots and leaves of carrots grown on an equal extent of land, and of similar quality, drawn and weighed on the 30th of November,			
		lb.	oz.
1810,	- - -	46	2
Weight of the leaves alone,	- - -	13	12
		<hr/>	
	Weight of the roots alone,	32	6

Thus it appears, that the roots alone of the carrots, the leaves of which were not cut till they were drawn in November, amount to a greater weight, than both the leaves and the roots of the carrots that were trimmed over on the 7th August, and that the difference on the whole was nearly 50 *per cent.* on the one produce, and to 30 *per cent.* on the other. This agrees with the idea, that the sap prepared by the leaves, adds size to the roots.

It is also proper to observe, that the weight of root,

which is the most valuable part of the plant, is nearly double in what was uncut in summer, whereas the extra growth of leaf, in consequence of summer-cutting, is only about 12 *per cent.* at the utmost.

In regard to the culture of carrots in Scotland, it has been ascertained, in the most satisfactory manner, that they can be raised on peaty soils with the greatest success.\*

\* The following account of this important fact I have received from a respectable proprietor in the county of Fife, and though already published, it may not be improper to reprint it in this place.

It is well known, that carrots delight in a soil where they find no difficulty in striking their roots downwards. Deep sandy soils were therefore recommended for that valuable article, but there is reason to believe that peaty soils will be found greatly preferable.

A gentleman in the north of Scotland, being desirous of cultivating that root, and understanding that celery throve well on peat, he resolved to try whether carrots also might not answer; and he pitched on an acre of low meadow-ground for that purpose, which might have been converted into peats for fuel. It was trenched in November, 1805, and a crop of oats taken in 1806. After the oats were removed, a moderate quantity of rotten dung, and some lime, were laid on the ground; it was then dug over with the spade, and in spring 1807 sown with carrots in drills.

In the beginning of the year 1808, the ground got a small quantity of dung, and was again dug over with the spade, and sown with carrots. The crop was very abundant, and some of the carrots measured eighteen inches in length, although the ground was only trenched to the depth of a foot.

The quantity *per acre* was from thirteen to fourteen tons, which was sold, when delivered at Leith, for 7 s. 6 d. *per cwt.* or L. 7, 10 s. *per ton.* The produce of an acre, therefore, when the crop answers, is immense, L. 101, 5 s. *per Scotch acre.* The value of carrots, as food for cattle, is well known, and it must be of peculiar consequence, therefore, in the Highland districts of the country, to cultivate that root.

From 168 to 200 carrots weighed one *cwt.*, and, when sold in the Edinburgh market, fetched, even the small-sized, 1 d. each, and the larger sorts 1½ d. and even 2d. each.

The principal difficulty is to get good seed. If that can be obtained,

There are difficulties, however, in establishing a more extensive culture of this plant in Scotland, at least in the western parts of it. A respectable correspondent remarks, that it requires a very favourable season, dry land, and in full condition, to produce a good crop, and unless it is also very clean from weeds, it requires very minute attention, and too much time, for persons not acquainted with their excellencies, to risk the chance of raising them in such quantities as might prove useful for stock. Parsnips are not only easier raised, but preserved, and have more nourishment in them than any other vegetable, as he has ascertained by feeding with them for many years, and distilling them.

The most satisfactory information which I have received, regarding the culture of carrots in Scotland, was from Mr William Scott, who had been land-steward for many years

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no crop will repay so well the expence of cultivation on a peaty soil. Suffolk is the best county for obtaining it.

The quantity of good seed required *per* English acre, is from 5 lbs. to 8 lbs. As farm-servants are not well acquainted with the culture, it is best to sow the larger quantity. The price varies, according to the season, from 1 s. 6 d. to 2 s. *per* lb. The proper season for sowing field carrots, is from the middle to the end of March. They should be sown in drills, but not in raised ridges like turnips, and not rolled. The drills should be eighteen inches apart, if drilled on level ground; but if done with a plough as turnips, they would require two feet.

To those who have peaty soils already in cultivation,† a trial of so promising an experiment is earnestly recommended, and that they would be pleased to communicate the result to the President of the Board of Agriculture.

† When peaty soils are first cultivated, they ought always to be trenched in the beginning of winter, and exposed to frost. If dug in summer, the heat of the sun hardens them, and converts them into peat for fuel. But old peaty soils may be trenched for carrots in spring. The produce has amounted even to 16 tons *per* Scotch acre.

to Admiral Elliot of Mount Teviot, in Roxburghshire, and to General Robertson of Lawers in Perthshire.

In the course of twenty-seven years' experience in the culture of carrots, he has found all kinds of soil nearly equally good for raising that root, provided it was old, well-fertilized land. Such he always chose out of the green crop or fallow plot, and the extent of ground he destined for carrots, was never less than three or four acres, and sometimes more.

The crop which preceded them was generally oats, for several reasons, 1. The carrots formed a part of the same field with other green crops; and, 2. They were more certain not to be cut down, or injured by the worm, when they were taken after a corn crop, than after the ley or grass one.

The ground was turned by means of a trench-ploughing, as soon after harvest as the oats were carried off the field, and lay in that state till the end of February; then it was worked with the plough and harrows to a loose mould, and was afterwards formed into ridges, 30 inches wide, and from 16 to 18 deep. These were formed by going twice round in the same direction somewhat similar to trench-ploughing, which raises the top to the above height from the bottom: by this method all the surface mould is accumulated.

The manure Mr Scott used for the first seventeen years, was rotted dung, turned over and prepared for the purpose; but since that period, he has always preferred a well-prepared compost of peat-moss and dung. About ten tons or double cart-loads were given *per* English acre, regularly spread in the bottom of the drills. In doing this, care should be taken, not to break down the ridges; for if this is done, the dung may be left too near the top of the ridges or surface, and the carrots would grow short, and full of

fingers or divided roots; whereas, when the dung is laid full 16 or 17 inches deep, not a single fork-rooted carrot will be seen. A singular proof of the advantage of laying dung deep, at least for carrots.

After the dung is spread according to the above-mentioned direction, the drills are split down, and raised up the same way as before, going twice round every ridge, in order that there may be fully 16 inches from the dung all of good mould.

The dung being at the bottom, makes the tap root of the carrot push immediately down, and swell to an enormous size, the roots being often 16 inches in girth, and 18 or 20 inches in length. Mr Scott has frequently had cart-loads of them picked out, and shewn as a curiosity, and not one of them of less dimensions.

Before sowing the seed, a rut is made along the top, about four or five inches wide, and three deep, by means of a hoe, to allow room to the plants to stand in this shape,  along the top of the ridge or drills, similar to double rows.

Many crops of carrots are lost by bad seed. The best and cheapest Mr Scott ever got was from Messrs Dicksons, Shakespear Square, Edinburgh. As the quality of seed varies in different seasons, he always tried it in a hot-bed, or something similar, on purpose to see how it sprung. This trial at once showed, what was the proper quantity to sow. Six, seven, or eight pounds, *per* English acre, sometimes produced a greater number of plants, than sixteen pound at other times, which quantity has been sown, and the plants were far from being too thick.\*

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\* It is the difficulty of procuring good seed, and the minute attention required in the culture of carrots, that renders them so rare in our fields.

Mr Scott has steeped the seed in brewers' draff or refuse, in wet sand, and in a wet bag, which several modes all answered the same purpose. When the seed is too late of being sown, many think steeping necessary; but he does not approve of steeping in *early* sowing, as the sudden transition from a warm, to a cold situation, checks the growth of the young plants. When the season is warm, the seed sown springs of itself, if the soil has moisture in it; if it has not, the seed had much better lie dry, till rain come, for half-sprung seed, sown in mould, without moisture, will dry up, and never again revive.

After the above-mentioned ruts are made, girls employed in the farm-work, got a proper portion of seed in their aprons, and turning their backs to the wind, they sow it of the proper thickness, walking gently down the furrows a certain number of steps to a handful, and causing their fingers and thumb to move so that the seed might drop equally along in the rut.

This mode of management has answered equally well in Strathearn, as in Roxburghshire. At Lawers, the crop in 1810, was 33 tons and 70 stones Dutch, produced from less than a Scotch acre-and-a-half of ground, of as fine, large, and clean carrots as could be wished for, which were used for horses, milch-cows, young calves, swine, poultry, &c. Several persons near Lawers, tried to raise that root, but did not succeed, owing entirely to improper management, and no fault of either soil or climate.

The tops make excellent green food for cattle, and could be made into hay, if at that time a season could be had to dry them.\*

Mr Scott has tried the seed which was got the summer

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\* The tops might be mixed with dry straw, and thus preserved.

following, from those which had been left in the field all winter, and it answered equally well as any other.

The best way to preserve carrots is, to top them close by the head of the root, and lay them gently down in a heap within a house. It must be done gently, for when a person throws them from him at a distance when topping, they are bruised by the fall, and are so damaged, that they soon spoil, in the same way as an apple, when bruised on one side. They should be turned over once a month, picking out the spoiled ones, which attention will make them keep sound till the end of April.

From the end of February to the first of April, carrot-seed may be sown; but early sowing is preferable.

The second thinnings of carrots, afford great relief to young pigs, as at that time no potatoes can be had. Upon the whole, no food is so good for young animals of all sorts as carrots.

About nine English pounds, will serve for a feed to an ordinary work-horse, a milch cow, or a bullock of from 35 to 40 stones. A barley firlo, which contains four pecks, will weigh from 70 to 72 English pounds.

When the ground is properly cleaned, an English acre of carrots, cannot be raised and stored into their winter quarters, under L. 5, 5s. exclusive of the rent of the land; but the value of the root, when the crop proves a good one, is immense.

An important discovery has recently been made in Scotland regarding the culture of carrots, that by raising alternate rows of carrots and onions, the former is protected from the depredations of insects, to whom probably the smell of the onion is offensive. This may easily be carried into execution in so far as regards gardens, if not to carrots cultivated in fields, and perhaps the same idea might be extended farther. As the smell of hemp is so injurious to the insect tribe, it might be grown as a protection to plants.

*Cabbages and Kale.*—I am informed, that cabbages, when properly cultivated, yield more food for cattle than any other crop whatever.\* Mr Waddel at Dockenyfould, near Glasgow, raised cabbages on his farm, at the rate of fifty tons *per* acre, and putting them up to the neck in earth, and covering them with straw, he thus preserves them for his cows till the month of February. This plan, however, cannot be adopted on a great scale.

The late Mr Scott of Craiglockhart recommended the cultivation of cabbages, as green food for cattle in autumn, and green kale for the same purpose during the months of March and April, which last is certainly the scarcest period of the year for food to stock, more especially in high situations. The kale, (greens or coleworts), however, are not found to be above two-thirds the value of cabbages, and often not half so valuable; and Mr John Shirreff is of opinion, that both kale and cabbage are infinitely inferior to turnip. They require much more expensive manipulation, or hand labour, and must be earlier put in, otherwise they do not arrive at any size. Thus, there is not the same opportunity for cleaning and preparing the land for the following crops in the rotation. They are not likely, therefore, to become prominent articles in the husbandry of Scotland.

*Rye.*—This species of grain is not so extensively cultivated in Scotland, as it ought to be, (for weighty crops of it might be raised on soils of the most porous and arid nature, and upon almost pure sand along the sea shore); and the

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\* It is said, that as the roots of cabbages weigh from one to two pounds each, and are of no use, they must occasion a loss to that extent: On the other hand, it is contended, that the roots both of kale and cabbage are much liked by stock, if sliced down for them.

winter sort, without which, the people living on the coasts of the Baltic, could hardly be subsisted, is almost unknown.\* My principal reason for mentioning it at all is, that on muirish grounds, rye has been found a more certain crop than oats; a fact little known, but of infinite importance in carrying on the improvement of our barren districts. Mr George Culley remarks, that rye, like oats, will answer on crude soils, without the application of calcareous manures, which renders that crop peculiarly calculated for waste lands, when first brought into cultivation. The principal objection, however, to the culture of rye in Scotland is, that it is an article for which there is at present but little demand, though that would not be the case, were distillation from grain permitted.

*Flax.*—This is an article that might perhaps be more cultivated in some parts of Scotland than hitherto has been the case, but it is far from being an unimportant one, even in its present state. It is supposed, that there are at least 5000 acres of flax raised in the country, producing above L.20 *per acre*, and consequently worth at least L.100,000, besides furnishing the raw material for a most valuable manufacture. The Board of Trustees at Edinburgh, have printed and circulated very useful directions for the culture and management of flax, with some observations also on the culture of hemp. This last article might be raised, with much advantage, on peaty soils, in the Hebrides, where there is such a command of sea-ware as manure, and where

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\* A correspondent informs me, that he has had 35 bushels of rye *per* English acre, upon land that would not have produced 20 bushels of oats. Indeed oats sown alongside of the rye, upon the same field, and on land, as nearly as could be judged, of the same quality, were scarcely worth the expence of reaping.

the people, more especially in the winter season, want employment. In regard to the culture of flax in the more improved districts of Scotland, Mr Shirreff is convinced that, if grown as a crop, and persevered in, it would prove destructive both to the tenant, and to the soil he cultivates; and Mr Kerr observes, that *a real farmer*, has no time for the minute attentions required in this branch of husbandry, nor land to spare, for laying it out to *grass* or *dry*.

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#### SECT. VI.—*Rotation of Crops.*

OF all the subjects included in the present enquiry, this, perhaps, is the most important, and the most difficult to discuss.\* The returns transmitted to me regarding this single point, exceed eighty in number, and would form a moderate volume. It is my duty to endeavour to compress that mass of useful information, within a moderate compass. With that view, I propose briefly to point out the various modes of cropping suggested in the course of the enquiry. It must depend upon the judgment of the farmer, to adopt those, which are best suited to the climate where he resides, the nature of the soil he cultivates, the size and situation of his farm, and a variety of other circumstances which will necessarily require his attention, in determining which ought to be preferred.

Every farmer must be aware, in fixing on his rotations,

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\* Even in gardening a rotation of crops is advisable. See Nicol's Gardener's Kalendar, p. 21.

that it is necessary for him to ascertain, not only the various articles for the production of which his farm is calculated, and which are likely to yield him the greatest profit, but also the succession in which these articles ought to be raised, so as not to diminish the fertility of his soil; or, as Lord Kames has well observed, so to intermix his crops, as to make the greatest possible profit, consistently with keeping his land in order.\*

The subject of judicious rotations, has been very ably touched upon in one of the first reports drawn up for the Board of Agriculture, by Mr Maxwell of Fletton. That intelligent farmer justly remarks, that after all the volumes that have been written on farming, a *rational system* is the only true ground-work of general improvement, and that those who carry into execution a profitable system of management, or, in other words, a judicious rotation of crops, bid fair to engage the notice of the neighbourhood, in spite of the impression of those habits which attach to unlettered farmers, and thus may be the source of essential service, both to the cause of agriculture, and to their country. Mr Shirreff justly remarks, that if a judicious system be adopted and persevered in, it must be completely bungled indeed in the execution, if it does not prove beneficial even beyond expectation; that is, the difference between a good and a bad system or rotation of crops, will be found greater, than could have been imagined by those, who have attended but

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\* Mr Church of Hitchill remarks, that to adopt a judicious mode of cropping, requires a degree of judgment in the occupier, which can only be obtained by experience and observation. Where the different processes are properly executed, (on which the profit of the farmer must greatly depend), the difference between a good and a bad system, will be found greater, than could have been imagined by those who have attended but little to the subject.

little to the subject. No *manner* or execution, he observes, can make up for defect of system.

On this part of the subject it may be sufficient to add, that almost the same crops, which, under one system, would be extremely unprofitable to the farmer, and injurious to his land, under another rotation, with an intervening green crop or fallow, might not only be profitable, but might promote its fertility. †

In considering this important subject, it is proposed shortly to discuss the following particulars: 1. The principles or maxims on which rotations ought to be arranged: 2. The various sorts of rotations which have been adopted in Scotland, for various periods of two, three, four, five, or for a longer period of years: 3. Of double rotations, where two systems are in a manner blended together, and carried on at the same time: And, 4. Any miscellaneous particulars connected with this branch of the enquiry.

### 1.

#### OF THE PRINCIPLES ON WHICH ROTATIONS OUGHT TO BE ARRANGED.

I have endeavoured, in the preceding section, to point out the various articles which are principally cultivated in Scotland. These articles must be raised, either constantly

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† Compare, for instance, the old course in the Carse of Gowrie, 1. Wheat; 2. Barley; 3. Oats; 4. Peas and Beans, when the crops were trifling,—with the new system, 1. Fallow; 2. Wheat; 3. Beans; 4. Barley; 5. Grass; 6. Oats. Under the first course the rent was only from 25s. to 30s. *per* Scotch acre. Under the second it has in many cases risen to L.5 or L.6 *per* Scotch acre, and upwards. The latter rotation, Mr John Shirreff remarks, would be improved, by having the clover after the wheat, instead of the barley.

on the same ground, or one year must be appropriated for the growth of one sort of crop, and the next for the production of another. There are few cases where the same land will constantly yield one and the same plant, or where a repetition of the same crop, or indeed of the same species of grain, without some interval, is not found to be injurious. Hemp is one exception to that general rule; for in Russia, the same ground invariably produces it, without either fallow or any intermixture of crops, but in consequence of great quantities of putrescent manure being annually applied. It appears from Mr Butterworth's experiments already mentioned, that carrots have been successfully cultivated for seven years, on the same ground. In some instances, bear or big has been sown for years on the same ground in succession, with the aid of sea-ware annually given to it. But in general, a change, or rotation of crops, has been found not only expedient, but necessary. Indeed every farmer who conducts his operations on rational principles, will be attentive to such a change.

The propriety of adopting any particular rotation, must depend on a variety of circumstances, more especially the following: 1. *On the climate*, whether it is wet or dry. Wet climates, for instance, are favourable to the production of oats, dry climates for peas, and for harvesting of beans;\* and the rotations to be adopted in each climate, ought to be formed accordingly. 2. *On the soil*; for clay, loam, or sand, have each various crops best calculated for them. 3. A rotation must also depend *upon the situation of a farm*, in regard to the probable sale of its productions: for instance, a large field of potatoes, which might be worth L. 25 per acre,

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\* Mr Rennie of Phantassie observes, that beans require moisture, and they never produce a full crop, on dry land, but in a wet season.

near a great town, might not be worth L. 5 in a remote part of the country.† 4. *On the means of improvement by extra manure*, as lime, marle, sea-ware, town-dung, &c.—The celebrated Dunbar rotation, of, 1. Turnips; 2. Wheat; 3. Clover; and, 4. Wheat, could not be possibly carried on, without the command of sea-ware, which that neighbourhood possesses: and, 5. The rotation must also depend *on the state or condition of the soil*, whether it be old cultivated land, or a new improvement; whether it be land which has been cropped judiciously, or by exhausting management; whether it is in good heart, or the reverse; whether it is foul or clean. No regular system of rotation can be adopted, until the land is regularly drained and cleaned, and put into good condition.

The maxims which have been recommended, as the best calculated to lay the foundations of judicious systems of rotation, shall now be stated.

1. A farmer could not well carry on his business, unless he had various kinds of crops upon his farm. For instance, had he nothing but wheat and beans, he might not be able to procure hay and oats for his horses, and so on. By having various articles also, he does not run so much risk, either in regard to the season, or to the sale of the produce afterwards. If a farmer entirely depended upon the culture of two articles, he might often be materially injured by

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† That able reporter, Mr Kerr, in his account of the Berwickshire husbandry, remarks, that unless near large towns, where potatoes are substituted for fallow or turnips, they never constitute a complete part of any rotation, because unsaleable, unless at prices inferior to the expence of their cultivation, and if universal, or even but a little more extended, they would be unsaleable almost at any price. Berwickshire Report, p. 214.

one unfavourable season; and if the article which he raised were not saleable, the land had better have remained unploughed.

2. To have the crops so arranged, that the labour of ploughing for each, of sowing, weeding, reaping, &c. shall proceed in a regular succession, and that the labour or business be not too much crowded on the farmer, at any one season of the year, nor any quantity of extra stock rendered necessary; but that the crops produced on the farm, shall be cultivated by the same hands, and with the same cattle. To this general rule, hand-hoers in spring and summer, and reapers in autumn, must form an exception.

3. To avoid forcing crops, or frequent repetitions of the same articles or species;\* as a diminution both in quantity and quality, except in very rare instances, never fails to be the consequence. By frequent repetitions of the same crops, (as Mr Scott of Craiglockhart remarks), the soil loses stamina, which neither manure nor cultivation can renovate. Great luxuriance in vegetation can be made to take place, without much real productiveness, as we see where grain is sown on the sites of dunghills.†

4. To avoid two white crops in succession, but alternately to have white and green crops. On this head, it is contended, that it is impossible to lay down general rules, without modifying them by such circumstances as are often only

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\* The celebrated George Culley is of opinion, that the greater distance the repetition of any sort of crop can be kept, the better, and that the rule holds good in regard to leguminous, as well as white crops. It would seem, however, from Mr Butterworth's experiments, that carrots are an exception.

† Mr Andrew of Tillilumb, near Perth, finds, that if clover is cultivated only once in eight years, the produce is not only about double, but that the succeeding crop of oats is better by two bolls *per* acre.

to be known by real practitioners: and though the system of alternate green and corn crops, is, beyond question, an excellent one in general, deviations from it may sometimes be admitted; for instance, when old rich leys are broken up, two crops of oats in succession may be permitted. This, however, is objected to by one of the ablest farmers in the kingdom, who maintains, that on dry lands, the second crop should be either turnips or potatoes, as the situation answers, and on clays, either beans or fallow, which in general will pay better than a second crop of oats.

5. To avoid crops likely to encourage weeds; and founded on this principle, Lord Kames objects to the culture of peas, which, if not an extraordinary crop, are apt to foster weeds. If the land has been previously fallowed for wheat, and thus cleared of weeds, peas, after wheat, he thinks, may be hazarded.\* This doctrine, however, is in a great measure superseded by modern improvements.

6. To raise those crops the most likely to be productive of manure; hence green crops are to be recommended, and barley is to be avoided, producing, when compared to other crops, the smallest quantity of straw.

7. On strong land, to sow clover with the crop after fallow, when a great produce may be expected, which in a great measure ensures abundant crops during the remainder of the rotation. Clover sown upon wheat after beans, is extremely precarious, and often fails.

8. To arrange the crops so as to keep the land in good condition, and increasing, rather than diminishing in point of fertility.† This is best accomplished by the alternate

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\* Gentleman Farmer, p. 143. Mr Robertson of Ladykirk considers peas to be a good crop previous to a fallow, to bring about land that has been smartly cropped, and lime has a good effect after peas.

† Mr Andrew of Tillilumb remarks, that it ought to be a leading max-

husbandry, (or white and green crops in succession), and giving every part of a farm, the advantage of being occasionally pastured. Near towns, and in the neighbourhood of sea-ware, the pasturing system may perhaps be dispensed with, but except in such situations, there will be found few situations of farms going on progressively improving, but where grazing for two or more years, every rotation has been adopted. On the other hand, where the pasturing system is followed, few instances have been found, where the farms have not gone on progressively improving.

9. To commence a lease with a meliorating system, but during the remainder of the term, to crop the land in such a manner, as to reap, *in moderation*, the advantage of the improvement that has been made. In forming a rotation, therefore, those articles should be included, which are the most likely to afford a profitable return to the farmer.

Keeping these maxims in view, the various rotations which have either been adopted by, or recommended to, the attention of the farmers in Scotland, shall now be considered.

## 2.

### OF THE VARIOUS SORTS OF ROTATIONS.

It is not unusual, in treating of this part of the subject, to consider rotations as they are applicable to different soils,

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im with all farmers, never to take a crop, but when their ground is in good condition. Hence their first care and chief study ought to be, how they may bring their ground into, and keep it in the best order, and not what they can *draw* or *take* for the season. If they are kind and generous, the grateful earth certainly will *give*, under proper management.

for instance, clay, loam, &c. ; but, on the whole, I think it more expedient, first, to discuss the different courses of crops, according to the number of years they respectively require to finish the rotation; some occupying two years, some three, some four, some five, &c. ; and then to explain what rotation is best calculated for each kind of soil.

### 1. *Rotations by Years.*

*Two Years' Rotation.*—In particular cases, some farmers have adopted a rotation of two crops. A field belonging to the Honourable George Abercromby, embanked from the Forth, carried, for several years, beans and wheat alternately. Upon his best loams, Mr Brown of Markle often takes wheat and beans alternately, summer-fallowing the ground, when its condition requires that process, but he considers the year in which the ground is summer-fallowed, to be the one in which he has the best crop. Mr Fairie of Farme, near Glasgow, has adopted the same system, giving a moderate dressing of dung every fourth year. Dr Charles Stuart, on his farm near Edinburgh, has tried a similar system on four acres-and-a-half of loam, the rotation being wheat and green crops alternately; but the latter were alternate potatoes and beans, both drilled. In the course of fourteen years, he has had, on this field, four crops of potatoes, three of beans, and seven of wheat. To every green crop, putrescent manure was applied; thirty tons at least to potatoes, and twenty-five to beans. The potatoe crops were all good: The two first crops of beans were very good: The third, indifferent. The crops of wheat were large, producing from ten to thirteen bolls, Linlithgow measure, *per* Scotch acre, or from 32 to 41 bushels *per* English acre. The only deficiency was in crop 1789, which averaged but

nine bolls *per* acre; that might be ascribed, however, to a season peculiarly unfavourable. There is no evidence of diminished fertility in the field, for in August 1810 it was covered with a luxuriant crop of turnips. It was perfectly free from couch-grass, and rooted perennial weeds, which are now in a great measure extirpated by hoeing and weeding, but it is still much infested with annual weeds, particularly the wild mustard and radish, which may be imputed to the use of Edinburgh dung, stored, from inattention, with the seeds of these, and other injurious plants, which the richness of the soil brings both speedily and universally to vegetate. Dr Stuart adds, that the quantity of produce from the above rotation has not diminished, but that, owing to unfavourable seasons, both the wheat and beans have degenerated in quality; and on this account, though the result might not be thought unfavourable by many, he would not adopt it, if he had a larger space of land on his farm calculated for wheat.

It is evident, that it is only in the richest loams, or most fertile soils, or where manure is plentiful, that such a rotation is at all practicable, and it is only under such circumstances that it is ever attempted.

*Three Years' Rotation.*—We shall next proceed to consider a rotation of *three crops*, and finding no instance of the sort in Scotland, it may not be improper, to give an example adopted by a native of Scotland, Mr Arbuthnot, who farmed in Surry. That respectable gentleman, and most intelligent farmer, practised, for nine years, a three-course system, viz. 1. Beans; 2. Wheat; 3. Clover, and when he quitted the farm where that plan was followed, he was fully persuaded, that he could have continued the same rotation for many years longer. This, however, was effected by means of London dung, which he had at command, and

which he gave to the bean crop. He also ploughed nine inches deep, with a swing-plough, the construction of which has been justly celebrated.

Other farmers have followed a similar system; for instance, 1. Potatoes, cabbages, or hoed crops, with manure; 2. Wheat; and, 3. Clover or grass: Or, 1. Hoed crop, with manure; 2. Half oats, and half barley; 3. Clover or grass.

Dr Coventry has made some observations upon these courses, to which he urges the following objections:—1. That there is rather too large a proportion of fallow or cleansing crop, more than what can be wanted in ordinary situations, to preserve the land free of weeds. 2. By there being but one-third bearing corn, it is less profitable than it might be. 3. There are two species of crops in the first example; which circumstance does not permit the labour to be sufficiently divided and extended over the year, and leaves too much to be risked on the success of a particular crop. 4. The quantity of straw obtained for food or litter, to live stock, must be rather scanty, or in a deficient proportion to what will in general be wanted.

The advantages of such a system, he states, in the following terms: 1. From the great proportion of green crops in this course, much manure will be procured, for all the straw will be converted into dung. 2. This scheme is calculated to render or preserve the land very clean of weeds. It may therefore answer as a beginning course, in situations where the ground is foul, and manure wanted; but it may be relinquished afterwards for a better one. It is not indeed in general use in any district, and has only been followed by some individuals, who have found it of benefit in the respects above mentioned.

*Four Years' Rotation.*—Rotations of *four crops*, however,

are by far more general, and will require more ample discussion. The first to be pointed out, is the celebrated Norfolk system, namely, 1. Turnips; 2. Barley; 3. Clover; and, 4. Wheat, which has been adopted in several parts of Scotland. Even in Norfolk, however, this course is no longer so generally recommended. It is considered prejudicial to the landlord; and, on a lease of twenty-one years, if constantly persevered in, it would not be found profitable to the tenant. Half the farm has annually a white straw crop, which, from the frequency of the repetition, would not be productive; besides which, the number of sheep and cattle kept under this system is comparatively trifling,\* when compared to the improved rotations which have lately been introduced. It is also much doubted, whether wheat will prosper so near the barley crop; and it can hardly be questioned, that without a plentiful supply of extra manure, both the turnip and the clover crop will fail, unless the land is refreshed by grass, for at least two or three years.

It may be proper to compare this rotation, with others on a similar principle, for dry soils.

In Roxburghshire, Mr Walker of Mellendean's rotation is, one-fourth in turnip and drilled beans; one-fourth in wheat and barley after turnips and beans, and sown down with grass-seeds; one-fourth in hay, soiling, and pasture-grass; and one-fourth in wheat or oats, after hay and pasture. In the light soils of Norfolk, neither beans nor oats

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\* Dr Coventry remarks, on the Norfolk system, that though the land on which this scheme is pursued, seldom, if ever, becomes by it less fertile, yet for poor ground it seems not to be sufficiently meliorating, or fitted soon to raise land to that degree of productiveness in which it is found to be the most valuable to the cultivator.

are cultivated, and beans are certainly not suitable to very light turnip land.

Mr Rennie of Phantassie, and Mr Brown of Markle, generally adopt, in their turnip soils, the following rotation: 1. Turnips; 2. Winter wheat, sown in spring,\* or barley; 3. Clover; and, 4. Oats. This is certainly a productive rotation, and it is strongly in its favour, that it is recommended by such eminent farmers, who are justly accounted at the head of their profession.

Mr Hunter of Tynefield's rotation is, 1. Turnips; 2. Wheat; 3. Grass, (mostly sheep-fed); 4. Four-fifths winter wheat sown in spring, and one-fifth oats. He adds, that under this rotation, the produce of his farm has been improved, both in quality and in quantity, since its commencement to the present time, *and continues to improve*. The additional quantity is to the amount of no less than  $1\frac{3}{4}$  bolls *per* Scotch acre, or 4 bushels *per* English acre.

I have now to state a course of cropping still more severe, which has been followed by some farmers in the neighbourhood of Dunbar, and to which I have therefore given the name of the *Dunbar Rotation*. The course is, 1. Turnips; 2. Drilled wheat; 3. Clover; 4. Drilled wheat. Being ex-

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\* In regard to winter wheat sown in spring, *after turnips*, an experienced farmer, (Mr Dudgeon of Prora); observes, that it may be safely sown as late as the middle of March, and it has succeeded even later, and that on fine land, it may be safely taken in preference either to barley or oats, if sheep have eat the turnips upon the ground. This is the most valuable, and the least expensive method of using them. But fine land, by this scheme, would be over-dunged, were it not for the practice adopted, of stripping out a part of the turnips, to the amount of one-fourth, one-third, or even one-half, (leaving the alternate rows), and carrying those drawn out to the cattle. When a certain breadth is thus stripped, the sheep-flakes can be set upon the drills which remain, and the stripping be carried on as they need more ground.

tremely anxious to ascertain, not only the details of this system, but also whether the plan, when persevered in, continued to be productive, I procured the following particulars regarding it, from Mr Hume of East Barns, and Mr Rennie of Oxwell Mains, two respectable farmers, by whom it is adopted. They informed me, that some deviations were occasionally made from the plan, (but not such as to alter the general system), by cultivating, on rich spots, peas, or beans, or potatoes, in lieu of turnips, and by having three green crops in succession, when the soil is much subjected to the growth of annual weeds, or requires to be refreshed. It would appear, however, that without a good climate, such as they enjoy in the lower part of East-Lothian, and great quantities of sea-ware, or other adventitious manure, it would be perfectly impossible to continue such a rotation. The quantity and sorts of dung usually applied, is, to the amount of about thirty double horse cart-loads *per* Scotch acre, to the land intended for turnips, whereas not more than one-half that quantity is given by the majority of farmers, and in many instances not more than twelve such carts. The turnips are always eaten on the ground by sheep, which is, (where the situation will admit of it), by far the best and cheapest method. The same quantity of dung or sea-weed is also applied on the grass land before ploughing. It is found, that applying the seaweed early in spring, on the clover to be cut, if laid on in dry weather, answers well for the succeeding crop of wheat. Notwithstanding, however, all these advantages, Mr Hume, in a recent communication, informs me, that he is now fully satisfied, that wheat will not grow with success, on light lands, every other year, for any length of time. After practising it for fourteen years, though by the force of manure, he could grow abundance of straw every other year, yet the grain at length turned out liker rye than wheat. He has

therefore tried oats, instead of the second crop of wheat; and indeed he would recommend, for a light soil, either a rotation of five, namely, 1. Turnips; 2. Barley, oats, or wheat; 3. and 4. Grass, two years pastured; and, 5. Oats, or a six-course rotation, where peas and beans will thrive; as, 1. Turnips; 2. Wheat; 3. Grass; 4. Oats; 5. Peas and beans; and, 6. Wheat.

The soil where this rotation prevails is of a dry quality. If such a rotation were attempted on wet soils, it would be advisable to sow oats after the grass, instead of wheat,\*

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\* Upon the trial of a small piece of grass, partly wheat, and partly oats, both close together, Mr Dudgeon of Prora actually had thirteen bolls of oats, and only seven of wheat, *per* Scotch acre, or 62 bushels of oats, and only 22 of wheat, *per* English acre. The wheat and oats were both sown near the middle of February, both equally well harrowed, and covered with the mould; but the former, besides being deficient in quantity, was much inferior to good wheat, while other spring-sown wheat, on such land, but not sown after pasture, was as fine as usual.

I am informed by Mr Brown of Markle, that a great many years ago, he made a trial of wheat and oats after clover, the result of which was clearly in favour of oats. He measured one acre of the clover land, and sowed the remainder of the field with wheat, and in the spring sowed the reserved acre with oats. Each acre of the wheat produced 8 bolls, which he sold at 21 s. *per* boll, or L. 8, 8 s. *per* acre, whereas the oats yielded 14 bolls of saleable grain, for which he obtained 14 s. *per* boll, or L. 9, 16 s. Besides, the land which carried oats, was in far better condition than the other.

Other intelligent farmers, also, object to wheat after grass. Mr Andrew of Tillilumb, near Perth, states, that if only one ploughing is given to wheat after grass, the slug-snail eats it up. This is also partly the case, though it gets several ploughings, unless they are given very early in the season, as thus he apprehends the ground does not yet get time to rot and pulverize, so as to gather that firmness and closeness which would prevent their lodging therein; and besides, he thinks that there is a *something* about the ground after grass, which is not congenial to

(and that is in general the preferable system, wheat being almost totally laid aside), but in land of a very dry quality, the drought is frequently very prejudicial to the crop of oats, which require moisture, and consequently should be sown early in dry climates. It is, however, owing to their being so late in sowing their grain, and to shallow ploughing, that oats do not succeed in Norfolk.

The principal objection to this system, according to Dr Coventry, is, that too much labour comes to be performed at one period of the year, and that too much is risked, or left dependent on the success of a single species of crop, an objection which merits the attention of every farmer, who

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wheat: hence, though the snail may not devour it about this time or in winter, it dies away in the spring, or blights in summer.

Another farmer remarks, that he sometimes sows a few acres of wheat, by preparing it with rag-fallow; that is, by giving the ley two or three furrows, and proper harrowings, to reduce the turf. However, if the loss of winter pasture, extra work beyond what an oat-crop requires, and the foul state the land is commonly left in, by this practice for fallow, is put to the debtor side of the wheat account, perhaps this method of growing wheat, does not prove more profitable than an oat crop. He has tried, he adds, wheat after grass, but never found it answer with only one furrow.

Mr Wight of Ormiston is perfectly satisfied, that oats in place of wheat, after grass three years old, or upon clover ley, is by far the most sure, profitable, and advantageous crop to the farmer, independent of leaving the land in much cleaner order; and that wheat upon a rag-fallow is a bad system, not equal to oats upon one furrow, and never fails to leave the land very dirty, besides the extra labour required.

In short, almost the whole evidence decidedly proves, that on all wet-bottomed lands, oats after clover, is of greater value than a wheat crop, and it is much more consistent with the rules of an improved system of husbandry. At the same time, *upon dry loams*, wheat will succeed after clover, if sown early, and repeatedly rolled, the openness of the soil, by which the roots are apt to be thrown out, and the attacks of vermin, being the great objections to this practice, which rolling will obviate.

considers the regular arrangement of rural labour throughout the year, as an object of the first importance.

One most important observation on this subject, has been made by Mr Rennie of Oxwell Mains, namely, that wheat sown after grass, early in autumn, often fails; but if sown in spring, it generally succeeds. It is never at the same time so good in quality, or so productive in quantity, as wheat after turnips, or even after peas and beans.

Mr Church of Hitchill, recommends a plan for cultivating wheat on a clover ley, which has been found to answer, and which seems to merit notice. He proposes breaking up the grass in the beginning of July, immediately after the crop of hay is taken off, or the land is out of pasture, then sowing it with rape or cole, after one furrow, and eating it down with sheep in September and October. As soon as that is done, the land should receive only one furrow, and should then be sown with wheat. This method reduces the land to a fine state, and at less expence than by a bastard fallow; and though the summer pasture is partly lost, yet the feed in September and October amply compensates for it. The ground is more sensibly enriched than by the summer pasturing, and rendered so fine, that the wheat crop could easily be drilled. By this method, the soil is not only put into a rich and mellow state, but that SOMETHING is removed which makes wheat after grass otherwise unsuccessful.

Mr Hume of East Barns observes, that it is more in the rotation, than in the mode of ploughing, that most farmers are deficient. He is convinced from experience, that peas are not calculated for East Lothian to any extent: if his lands therefore were unfit to carry beans, and were dry enough for turnips, he would consider the four-course shift of, 1. Turnips; 2. Oats, Barley, or Wheat; 3. Grass; and; 4. Oats, as the best mode; and if the farm were so situated,

as not to be able to give a thin dunging every fourth year, in the turnip drills, in that case let the grass remain two, or even three years old, so as to require only a fifth or sixth part annually dunged. If the lands were clay, consequently unfit for turnips, he would take fallow, wheat, grass, and oats; the grass to remain one, two, or three years, as above. The grass, after the first year, would pay little on clay lands, but when in grass, there is no expence, and all the other crops must be good. On land that will carry beans, he thinks, a six-course shift the best, which will afterwards be described.

On land calculated for that system, 1. Fallow or fallow crops; 2. Wheat; 3. Clover; and, 4. Oats; is peculiarly advantageous; and from the profits resulting from the adoption of that rotation, an active and intelligent farmer, (John Tennant, Esq. of Girvan Mains, in Ayrshire), has gradually been enabled to stock three different farms; and beginning with a rent of only L. 50 *per annum*, he now annually pays L. 2700, or *fifty-four times* the sum he originally paid, when he commenced his professional business. There can hardly be a stronger argument in favour of that system.

Mr Brodie of Garvald, in an upland farm, where the fixing of a proper rotation is of peculiar importance, adopts the following course: 1. Turnips; 2. Barley; 3. Grass; 4. Oats. He recommends the red oat in particular for such situations; and in the more northern or higher situations and districts, it is probable that bear or big would be better than barley.

The rotation of four crops adopted near Edinburgh, namely, 1. Potatoes; 2. Wheat; 3. Clover; and, 4. Oats, is a very productive one, but unfortunately, is only calculated for the neighbourhood of great towns, where ample supplies of putrescent manures can be purchased. Where

dung can be obtained in abundance, this rotation is the most productive of any, in so far as regards the potatoe and wheat crops; but the clover often fails, unless the land is ploughed deep, and kept clean. Where clover fails, and dung abounds, it might be advisable to raise alternate crops of potatoes and wheat.

We shall now proceed to state rotations of four crops calculated for clayey soils.

In thin clays, a four-course shift is recommended, as, 1. Fallow; 2. Bear, or Barley; 3. Clover; and, 4. Oats; because such soils become worse the longer they remain in grass. It is thought, however, by many respectable farmers, that the clover should be pastured, not only for one, but for two years, and that the rotation should be extended to five years.

On the estate of Monorgan, in the Carse of Gowrie, the following rotation was adopted on a fine friable dry clay, and has been for many years followed with much success: 1. Fallow; 2. Wheat; 3. Drilled beans; and, 4. Wheat.

A farmer, who has taken about 300 acres in that district, at the rent of about L. 6, 10s. *per* Scotch acre, proposes to adopt the following course: 1. Beans; 2. Wheat; 3. Clover; 4. Wheat.

This rotation, however, is strongly objected to from a number of respectable quarters. It is said, that clover never answers after beans and wheat, and that wheat after clover, is very *precarious* on the best of soils, and cannot therefore be depended upon during a long lease, as a source of profit. The crops of beans and clover cannot afford that rent; and no allowance is made for summer-fallow, though the practice cannot be dispensed with in the Carse of Gowrie. The idea of having one-fourth of a farm under beans, as a preparation for wheat, in so moist and change-

able a climate as that of Scotland, would never answer, as it is very difficult, even in favourable seasons, to sow any quantity of wheat after beans. Oats, instead of the second crop of wheat, would be a great improvement on this rotation.

*Five Years' Rotation.*—Rotations of *five crops*, have in many cases been recommended, both for strong and light lands. The excellent rotation on the farm of Stodridge, 1. Turnips; 2. Barley, or Spring Wheat; 3. Hay, or cut Grass for soiling; 4. Pasture; and, 5. Oats, has been already explained, (p. 129), as the best system for cultivating a turnip soil, with the smallest number of horses.

Mr Rennie of Oxwell Mains thinks, that a rotation of five, 1. Turnips, or plain fallow; 2. Wheat; 3. Grass; 4. Peas or Beans drilled; and, 5. Wheat, would, if well executed, answer well on light soils, having a powerful tendency to exterminate weeds. He does not think, that there can be any loss in having a plain fallow, even on the driest soils, it being almost next to an impossibility to clean land so well with green crops, but that there will remain a great many root-weeds, so very prejudicial to the soil. The proper time for doing this effectually, is in July or August, and must be accomplished by deep ploughing, which can never be performed if the land is under a crop. The rotation of five, above detailed, is what he means to adopt, if his land tires of wheat every other year; but while the wheat turns out in the manner it has hitherto done, for these some years past, he will certainly continue his present system of, 1. Turnips; 2. Drilled wheat; 3. Clover; and, 4. Drilled wheat, the most advantageous rotation that can well be adopted in such soils. Beans also, except on Mr Andrew Knight's new system, (that of sowing beans on turnip drills, after the turnips are consumed), do not

answer on light soils; and in regard to peas, on an average of years, they are to be estimated at little more than the value of their straw for fodder.

Above forty-two years ago, John Mackenzie, Esq. of Glasgow, adopted the following system: 1. Potatoes; 2. Wheat; 3. Grass; 4. Pasture; 5. Oats;—a plan which, he maintains, has not yet been improved upon. On the subject of cropping, Mr Mackenzie observes, that whenever the farmer discovers, that he can be as well paid, by cultivating food for the use of cattle, as for man, from the increased quantity of manure procured under that system, Britain will cease to find it necessary to import corn. Grain, he adds, should in general never be sown, but when the ground is laid down to grass, or ploughed from it.\*

On light soils, of moderate quality, a five-field course is adopted, by that intelligent farmer Mr Charles Alexander, viz. 1. Turnips; 2. Grain; 3. Grass; 4. Grass; 5. Grain.

Upon moss or peaty soils, after effectual draining, the following course is recommended: 1. Potatoes or turnips; 2. Barley or bear; 3. Clover; 4. Pasture; and, 5. Potatoe oats, which would prove a most advantageous crop. Peaty soils, however, are apt to get puffy by tillage, and require, in general, more pasture to consolidate them.

Mr Maxwell considers the following course of crops, for five years, as preferable to every other: 1. A cleansing

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\* Mr Curwen concurs in these sentiments. He remarks, in his Report to the Workington Society, *anno* 1810, p. 103, that the first lesson in modern husbandry is, to correct and control too extensive ploughing, which is effectually done, by confining the tenant to alternate white and green crops. The proportion of green crops, with few exceptions, is too little, even in the best cultivated farms in this country. When this shall be fully understood, a great and essential point will be gained, and the progress of good husbandry will become very rapid.

crop of whatever kind is best suited to the soil, as turnips, tares, or cole-seed, to be hoed, but not to stand for seed; 2. A crop of white corn of the kind best suited to the soil, to be laid down with clover; 3. Clover, either grazed or mowed; 4. Beans, where suited to the soil, sheep-fed and hoed, or some such meliorating crop adapted to the soil; 5. White corn suited to the soil: † and he contends, that however various our soils, and however different in their nature, the same order or course of cropping ought to be pursued, (fen lands always excepted), changing only the species of our corn and vegetables, and adapting them to the nature of the soil we have to work upon, and the demand in the market for the articles that are cultivated.

It is certain, that by such a state of cropping, a soil of tolerable natural fertility, might not only be supported without foreign aid, but might increase in fertility. Dr Coventry on this subject has well observed, that when crops, *intended to ripen their seed*, are objects of culture, there is only wanted a degree of vigour and luxuriance in the plants, sufficient for that purpose; and if the fertility of the soil be raised to a higher pitch than is necessary, or consistent with that object, injurious, rather than beneficial, effects, may be the consequence. Land may be too rich for corn crops, and it is better to keep it in a *well-balanced condition*, or in a medium state of productiveness, than in too fertile a condition; besides, the climate may be unfavourable for pulse crops, in which case a second year of herbage would be preferable to beans or peas.

We shall now proceed to consider the rotation of *six crops*, which is deservedly a favourite system in Scotland.

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† It is remarked, on this system, that some corn-crop, as oats, ought to follow the clover, and not beans.

*Six Years' Rotation.*—In a light soil near Alloa, Mr Kerr of Lorne's Hill has adopted the following rotation: 1. One-half potatoes, one-half turnips; 2. One-half wheat after potatoes, one-half oats after turnips; 3. Hay; 4. Pasture; 5. Oats; 6. Barley. Here, however, there are two white crops in succession. Perhaps it would be advisable to convert it into a rotation of five, leaving out the barley or the sixth crop, and putting barley instead of oats after turnips the second year. Nothing can succeed barley with so much advantage, as clover and grass-seeds. Mr Rennie of Phantassie likewise observes, that in good lands, pasture ought never to succeed hay, which ought to be taken as a crop, and ploughed after.

Mr Robertson of Ladykirk proposes the following rotations on a good soil: 1. Potatoes, or turnips; 2. Barley; 3. Grass; 4. Potatoe oats; 5. Beans; 6. Wheat. On inferior soils, 1. Turnips, or fallow; 2. Wheat, or oats; 3. Clover; 4. Pasture; 5. Pasture; 6. Angus oats.

On all the strong lands in the Carse of Gowrie, and in other fertile districts in Scotland, the following rotation of six crops, with some variations, is considered as preferable to every other: 1. Fallow; 2. Wheat; 3. Beans; 4. Barley; 5. Grass; 6. Oats; and, as it seems to be admitted, that on strong lands in Scotland, fallow is necessary once in six years, there cannot, on the whole, be a better system for such soils. Where wheat can be taken the fourth year, instead of barley, the produce is still more valuable. By some farmers, the course is altered in the following manner: 1. Fallow; 2. Wheat; 3. Clover; 4. Oats; 5. Beans; 6. Wheat. This seems to be on the whole the best system, for the clover will produce a more abundant crop when it succeeds wheat after fallow, than when it is the second crop after beans; and Mr Rennie of Phantassie observes, that this system will be less expensive in the culture than

the preceding one. All these rotations, however varied, are founded on the acknowledged principle, that the alternate husbandry is the most advantageous.

Since the decrease of the value of barley, and the great demand for wheat, they have, in the Carse of Gowrie, in some degree, deviated from the regular system above pointed out, by sowing about one-half of the fourth division with wheat and grass-seeds, to bring the grounds again into a proper rotation, in order that the whole fifth division may be under grass; and still farther to increase the quantity of wheat, a great part of the sixth division is often sown with wheat instead of oats. By thus stealing from the barley and oat divisions, which is done *only in favourable seasons*, there is often one-third part of the farm in wheat, instead of one-sixth part, as the rotation before points out. Such practices, however, cannot be recommended, as good clover cannot be expected with wheat that has succeeded beans.

On the subject of this rotation, it is only necessary to add, that some intelligent farmers disapprove much of sowing wheat on limed fallows, being so frequently thrown out of the soil, the lime opening the soil, and admitting the frost; the consequence frequently is, little more than half a crop of inferior wheat. Some change, therefore, in the rotation in this respect, or some other mode of application for the time, would be advisable. Mr Dudgeon of Prora very properly suggests, that perhaps barley on the fallow, having been so little sown for many years past, would be extremely productive; and Mr Wight of Ormiston has no hesitation in declaring, that barley, instead of wheat, on limed fallows, without dung, if sown on the winter furrow, would be a very productive, and not a precarious crop. Some farmers have, it is said, found by long experience, that barley is a better crop after fallow, than wheat, the

great pulverization that the soil receives during the fallow, being admirably calculated for that crop. About thirty years ago, indeed, barley used to be the first crop after fallow in Scotland. But the price of wheat is so much better, that it is extremely hostile to any change of system.

*Seven Years' Rotation.*—The following rotation of seven years, is strongly recommended: 1. Grain from pasture; 2. Turnips; 3. Grain; 4. Clover; 5. 6. and 7. Pasture. As the pasture is never so good after cutting the clover, it is usual to make no more of it into hay, than merely serves the horses on the farm, and to pasture the far greater part of the clover crop. This plan gives great crops of grain and turnips.

## 3.

## OF DOUBLE ROTATIONS.

There is a mode of cropping to which I think the name of a *double rotation* may be given. It is, where a particular course has been laid down, but where part of the farm is alternately put under different crops, so as to prevent too frequent a repetition of the same sort of grain, on the same spot.

There is a sort of double rotation frequently practised in Berwickshire, where a part of a farm is preserved in grass for three, four, or five years, then brought into the regular rotation, and another field taken out of it. Mr Thomson at Bewlie in Roxburghshire, has adopted this plan with much success. His rotation upon the dry-soil division of his farm is, 1. Turnips or fallow; 2. Wheat, barley, or oats; 3. Clover, partly cut and partly pastured; and, 4. Partly wheat, but principally potatoe oats; but he has a fifth divi-

sion which is kept in grass, and which is thrown out of the rotation for three, four, or five years, and then brought in again; so that each division, in its turn, remains in grass for that period of time, in the course of twenty-one years' lease. In lands which are not naturally fertile and productive, this plan must be attended with advantageous consequences. Every part of a farm thus derives a proportional share of the advantage of being kept in grass, which is infinitely preferable to the plan of preserving one part of a farm constantly in grass, and the remainder under a rotation of crops.\*

## 2. Rotations according to the Nature of the Soil.

According to the nature of the soil, rotations may be calculated for, 1. Clay-lands; 2. Loams; and, 3. Light soils; and for all these soils, the six-course shift seems, on the whole, to be the preferable system.

1. *On Clay Land.*—1. Fallow; 2. Wheat; 3. Clover; 4. Oats; 5. Drilled beans and peas; 6. Wheat.

Barley is excluded from this rotation, not being very favourable to the growth of wheat, and the latter being so much more valuable. Peas should be mixed with the beans,

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\* Another specimen of a double rotation is that recently adopted in the estate of Mr Coke of Norfolk. That eminent agriculturist stipulates for a course consisting of, either five or six crops. The five-course is, 1. Wheat; 2. Turnips; 3. Barley; 4. Clover; 5. Grass. The six-course is, 1. Peas; 2. Wheat; 3. Turnips; 4. Barley; 5. Clover; 6. Grass. But it is now ascertained, that for a district possessing a soil and climate similar to that in the neighbourhood of Holkham, a double rotation, or the alternate use of the five and six course system, is the best husbandry, because peas will not succeed above once in ten years.

and sown at the same time, in the proportion of about one-fourth. Five firlots of the two sorts, or twenty pecks *per* Scotch acre.

2. *On Loams*.—1. Turnips or fallow; 2. Wheat or barley; 3. Clover; 4. Oats; 5. Peas or beans; 6. Wheat.

This, on its proper soil, is a most productive rotation; and lands to which it is adapted, will pay the highest rent. It can hardly, however, be long persevered in, except in very fertile land, assisted by foreign manure. The winter wheat may be sown in spring, after turnips, till the 1st of March, and barley afterwards.

A most intelligent farmer on the Borders, recommends the following rotation on such a soil: 1. Turnips; 2. Winter wheat sown in spring till the middle of March, and barley after the later-eaten turnips; 3. Seeds, (either clover alone, or clover and rye-grass), with a mixture of a little yellow or hop clover; 4. Oats; 5. Beans; 6. Barley or wheat. As wheat after beans, though bulky, is very apt to be coarse in the grain, he thinks that barley ought to be preferred,\* giving the ground two or three furrows, which leaves the land in an excellent state for turnips. He finds, that early oats after clover, is invariably, on all friable soils, the most beneficial crop, producing seldom less than 60 Winchester bushels *per* English acre, and much more profitable than wheat, which is so apt to be mildewed. This course divides the crops in a most advantageous manner; all the most valuable grains are grown without any two in the same course, except a little barley twice, owing to a part being sown after the late eaten tur-

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\* Others prefer wheat, as the crop is a sure one, if the beans have answered; and it is only on particular soils that the grain is coarse.

nips. Some farmers sow oats after turnips, because, in the northern districts, barley is frequently so cheap, and sometimes lower in price than oats. But barley, to a certainty, answers best to sow late after turnips, and oats are found, by long experience, to do worse after turnips than any grain. Besides, clover seldom does well amongst oats, rather better among barley, but invariably the best with spring-sown wheat. Amongst barley, if not lodged, they will succeed; but from the rich state the land is in, barley is apt to lodge, which ruins the seeds, except sprat or battle-door barley is sown, which seldom lodges. Grass seeds never fail among spring-sown wheat, which is not so apt to lodge as winter and autumnal-sown wheat, or perhaps any other grain. Mr John Shirreff also remarks, that as the wheat is sown earlier than the barley or oats, so is the clover, and this early sowing secures moisture, and promotes vegetation.

Many respectable farmers, however, prefer potatoes to turnips, as a preparation for wheat; and Mr Aitchison of Clements Wells informs me, that in 1809 he planted seven acres of potatoes, and seven acres of turnips, in the same field, and in a good soil and climate. After the potatoes, he reaped 40 bushels *per* Scotch acre, and after the turnips only 20. The first was sown in November, the last in February. He is positive in regard to the produce, as it was threshed from the field.\*

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\* On this experiment it is remarked, that the result of this trial does not prove that potatoes are preferable to turnips as a preparation for wheat; but only that wheat sown in November, is a surer crop than what is sown in February. Had the turnips been removed in November, or at the same time with the potatoes, the experiment would have been more decisive.

3. *On light Soils.*—1. Turnips or potatoes; 2. Oats or barley; 3. Grass; 4. Grass; 5. Grass; 6. Oats. Even light soils, under such a rotation, would be productive, and, instead of being exhausted, would improve in fertility. The grass, if it can be avoided, should not be made into hay, unless where sheep have been fed on it, with turnips.

If, in addition to the rotations of six crops, one-seventh part of a farm were thrown into grass, for three, four, or five years, in the manner already described, so as to extend the rotation,—agriculture, on good soils, in so far as regarded the rotation of productive crops, and the preservation of the land in a state of permanent fertility, would be brought to a considerable degree of perfection, capable, at the same time, of improvement, where the whole mind of an active and intelligent farmer is devoted to the cultivation of his land. For instance, I have no doubt, that in the generality of turnip soils, Mr Hunter of Tynefield's system, described in the Appendix, No. XIII., might be adopted; namely, 1. Turnips; 2. Wheat and barley; 3. Clover; 4. Oats or wheat, provided soiling were adopted, and the whole straw of the farm were converted into manure. In regard to strong lands, the system of, 1. Rape; 2. Barley; 3. Clover; 4. Oats and wheat; 5. Beans and peas; and, 6. Wheat, which may be entitled to the attention of the practical farmer.\*

4. *Miscellaneous Particulars.*—Some particulars still remain, which it was difficult to comprehend under any of the preceding heads.

1. When any farm or district begins to be improved, it is necessary to commence with what may be called *gentle*

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\* See vol. ii. p. 83.

*rotations*; that is to say, with crops not likely to exhaust the soil. When the late Earl of Findlater began his improvements in the county of Banff, every field was kept for four or five years in grass, before any white crops were taken from it. The soil was thus enriched, and is now enabled to undergo more severe cropping. Fairlie's rotation in Ayrshire was of the same description: the land was pastured with dairy stock *for six or nine years*; lime was then applied, and three successive crops of oats were taken; then a crop of hay, and afterwards the land was pastured as formerly. This system, though now justly reprobated, was probably suited to the times when it was established, and laid the foundation of the present fertility of Ayrshire. Mr Church of Hitchill observes, that for moderate soils, having no other manure than what they produce, the rotations must at first be extremely gentle, if ever they are intended to be put in a progressive state of improvement. Mr Park of Windy Mains, near Dalkeith, observes, that he is also under the necessity of adopting a gentle rotation, as his land is of very weak quality, originally all *outfield*, being mostly covered with whins and heath not many years ago.

2. It is remarked, that near towns, where adventitious manure may be obtained at pleasure, any fixed rotation, to be invariably followed, is not so necessary; on the contrary, that farmers, in such situations, ought to change the particular articles they cultivate, according as a demand is likely to arise for each, without deviating, however, from the general principle of cultivating alternately green and grain crops.

3. Mr Drummond of West Bank, in the Carse of Gowrie, has tried flax on strong lands, as a preparation for wheat, but he found that flax is by no means a sure crop in that description of soil, and that the succeeding crops were very deficient, although the ground got more ma-

nure. He found, at the same time, that the wheat after flax, was better in quality than after any other crop, but it was deficient in quantity about one-fourth, compared to wheat after fallow, and the after crops were still more so, in proportion.

4. There is a general inclination, to assimilate any rotation of crops, and other agricultural practices, to the particular district or place where the individual resides. This is a radical error, because in agriculture, given situations must be nearly similar in many respects, before any positive inference can be drawn from any system recommended. It may be very possible that the soil on Tweedside, may be better than in the vicinity of Edinburgh or Glasgow; but the command of manure, and the disposal of many marketable commodities, is prodigiously in favour of the latter, and must constitute a great difference of rent and value. The soil from Dunbar, eastward to Dunglas, is not naturally of a very superior quality, but in that corner, they have a command of sea-ware, in superlative abundance, in so much, that in many instances, their turnips are grown with sea-weed alone,\* and the dung of their farms, applied to their barley land, and clover to grow wheat. This cannot be done in other places. This command of sea-ware, has been estimated at 20s. *per* acre on their rental, but it is certainly worth more. Added to this, their climate is better than the generality of Scotland, and from that circumstance, their grain, turnips, hay, and even their straw, is considerably more valuable than what is generally to be met with.

5. It may be proper to conclude with observing, that in the opinion of a most intelligent agriculturist, (Mr Logan

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\* What a treasure this hint ought to be in the Western and Orkney Islands.

of Fishwick), farmers have been induced, in many parts of Scotland, from the high prices of corn, to plough too much; and there is reason to apprehend, that the great source of manure, namely stock, being neglected, sold off, or almost given up, that the soil will be exhausted by the severity and weight of cropping,—a circumstance which, in the course of a few years, must produce serious mischiefs. Importation being permitted, grain cannot rise in price in proportion to the decrease of the produce on the fields, in consequence of the land not being refreshed, and enriched by grass and stock. The result must be, that the price of stock will rise enormously on account of its scarcity, a circumstance which cannot be remedied under a succession of years: for, first, the lands worn out must be fallowed, and laid down to grass, which would not be, for a few years, so fit for sheep as old turf; and next, stock must be bred for pasturing the land after it is laid down. The supply of Highland cattle has been of late rather less than formerly, of course the prices higher, which also will raise the price of other breeds. Another difficulty will also occur; farmers, who had excellent flocks of sheep of the Leicestershire breed, have rashly parted with them, for the purpose of turning their farms into tillage, and cannot get such flocks again, but at a great expence, and after a lapse of years.

On the whole, the convertible system of husbandry, where one-half of a farm is in grain, and the other half in grass and green crops, is in general to be recommended. By the grain crops, a sufficient quantity of straw is provided, to assist in feeding cattle, where that system is partially adopted, or for being converted into dung, in addition to a reasonable profit to be derived from the grain. By the grass and green crops, a number of cattle are well kept both in summer and winter; and when they are well littered as

well as fed, a regular and sufficient supply of valuable manure is secured. By this means also, the cattle are so well kept during the winter, that should a late spring ensue, or a scarcity of grass be apprehended, and consequently an overstocking, (an event which cannot be too anxiously guarded against by the farmer), a ready market will be insured for them, in districts where their food is more abundant.

It is to be hoped, that with the assistance of the facts and observations above detailed, no farmer will find any difficulty in arranging his crops, so as to produce profit to himself, without injuring his land, or diminishing the fertility of that great source of national prosperity and subsistence.

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#### SECT. VII.—*On the Sowing of Seed.*

The points which it is proposed briefly to discuss in this section, are, 1. The important subject of sowing crops drilled or broad-cast; 2. On the advantage of sowing early; 3. Whether a furrow should be stale or recent; 4. On sowing old seed-wheat or new; 5. On the pickling of seed-wheat; and, 6. On a change of seed.

1. It has long been a subject of dispute, whether it is most advisable to sow the different crops usually cultivated on arable land, drilled or broad-cast. Without entering into so wide a controversy, I shall endeavour shortly to state the opinions entertained by the intelligent farmers, with whom I have lately corresponded, on the subject of Scottish Husbandry.

- It is universally admitted, that it is the most advantageous system, to drill turnips and potatoes, and that drilling, in regard to these articles, is greatly preferable to the broadcast mode, for the following reasons: 1. As it carries off the extra moisture in wet soils; 2. As it exposes more surface to the atmospheric influence, by which the soil is meliorated; and, 3. As it gives an additional opportunity for the vegetation and the destruction of weeds.\*

It would appear likewise, from the experiments of Mr Butterworth and others, that drilling carrots is an advantageous system, as the plant can thus be cultivated on soils, where otherwise it would hardly be practicable, the drills furnishing an artificial depth of soil in which they can be raised.

The most intelligent Scotch farmers approve of the system of drilling beans, as the pods of beans are placed on the stem from the root upward, and of course derive essential benefit, when filling, from the admission of air by the open space left between the drills. This is universally admitted on light or loamy lands; but where the soil is of a strong and stubborn nature, the broadcast system is in a few cases preferred, more especially in the Carse of Gowrie, it being found difficult, it is said, in a rainy season, to perform the necessary drilling operations in clay, which renders the crop uncertain and precarious, and not a cleaning one.† As there is no comparison between the

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\* Remarks by Captain John Henderson of Aimster, in Caithness. Some prefer turnips broadcast, imagining that they are better protected from the frost, by the earth, than when raised in ridges; in which case the earth is apt to fall from them.

† Observations by Mr Peter Jack of Moncur. These reasons, however, are objected to. Mr John Shirreff remarks, that even in the wet-

two systems, any doubt on the subject can only arise from differences of climate. Besides, as Mr Robertson of Ladykirk observes, every season is not wet; in wet weather, a smothering crop may always be obtained by drilling; and in a dry one, by that process, the land may be fully cleaned.

Many farmers also drill their peas, more especially in light and pliable lands; but on strong clays, it is maintained that peas sown broad-cast succeed better. Mr Wight of Ormiston observes, that upon clay soils, and more especially in high situations, the broad-cast system can be sooner got at than the drilling one, and in a rainy season or backward spring, the latter operation cannot be easily performed, the crop consequently must be precarious and late. It is remarked by Mr Stewart of Hillside, that peas sown in drills, may be calculated for cleaning the land, but not for obtaining a crop; and Mr Charles Alexander observes, that he has several times attempted the drilling of peas, but never with success; the slender nature of that plant, not admitting of horse-hoeing, except when young; and as it is not of upright growth, not well even then. As that plant supports itself by the plants taking hold of one another, the interstices prevent the tendrils from getting hold, except in the row, when the wind blowing across the drills lays them over on one side, and retards their podding. This may be the case when crops are drilled at wide intervals, but the rows should not be above from twelve to fifteen or eighteen inches from each other. Peas, when drilled, should always be fully

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test seasons, a certain portion of cleaning can certainly be exhibited by hand-hoeing and hand-weeding, besides the regular admission of air, which is peculiarly wanted in a rainy season.

hoed, cleaned, and finished, before the 10th of June. It is contended, that they may always be drilled by a proper machine, when the land can be harrowed, and that the objections to the drilling of peas are groundless.

In regard to white crops, some eminent farmers, Mr Brown of Markle in particular, consider the advantages of the drill system, for white crops, to be at best problematical.\* The intelligent farmers, however, in the neighbourhood of Dunbar, whose lands are subject to annual weeds, and who sow a great deal of wheat in spring, have adopted the drilling system with much success, and consider it essential for the culture of their land.

Some experiments made by Mr Hope of Fenton, East Lothian, are among the most satisfactory and decisive I have met with, on the subject of drilling. From them, he is inclined to draw the following conclusions: 1. That it is of no advantage to drill winter-sown wheat, as the crop is rarely injured by annual weeds, and where the soil is infested with root-weeds, as the crop, in ordinary cases, will completely meet in the rows, before the root-weeds make much appearance, it is impossible, without injuring the crop, to render much benefit to the land with the hoe.

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\* One of my correspondents remarks, that in regard to the drilling of white or culmiferous crops, he has had no experience; but it appears to him, that the operation is tedious and minute, without any adequate benefit. The drilling of these can never be meant for cleaning the ground; a very good farmer will have it clean before they are sown in it. It is not so easy, however, to get the better of annual weeds. Mr George Culley was of opinion, that the drilling of white crops, was not productive of greater crops of grain, so far as his experience reached; but drilling is essential for the extirpation of annuals. The Culley family, were under the necessity, therefore, of drilling many of their white crops at Wark, and their other farms, until the *yellows*, (runches, red-backs, or charlocks, as they are sometimes called), were completely eradicated.

2. On all land, however, where annual weeds are abundant, he considers it of great importance, to use the drill for white crops of every description sown in the spring, it being understood at the time, that plenty of hands can at all times be obtained for using the hoe; for it is better to sow in the common method broad-cast, than to drill without hoeing.

Mr Hope adds, that an experiment was tried in his neighbourhood, which places the advantage of drilling in a very favourable point of view. A field of grass land, of good quality, which, in consequence of imperfect cultivation, was full of annuals, was all drilled, with the exception of six ridges, in different parts of the field, which were sown broad-cast, that the difference of produce between the two might be ascertained. The drills were made at a foot distance between the rows, and the drilled part of the field was hand-hoed, during the summer, at the expence of one guinea *per* acre.\* The difference of produce was very great, for the broad-cast yielded only nine bolls *per* Scotch acre, whereas not less than 15 bolls was the produce of the other.

Among the advantages of drilling, Mr Hope states, that he has uniformly found the expence of cutting a drilled crop in harvest, less than what was sown broad-cast; the difference being in this proportion, that three reapers, will do as much work in the former case, as four in the latter.

Mr Church of Hitchill recommends drilling wheat crops, not only for the purpose of having an opportunity to era-

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\* Mr Scott of Craiglockhart recommended the Dutch hoe as the best, for the operator proceeds backward, leaving the wrought ground and cut weeds untrod; the work is also much lighter, as less force is requisite, and stooping unnecessary.

dicare weeds by hoeing, but to give the grain a good hold of the ground,\* which may prevent the frost throwing it so easily out in the spring, and the wind loosening the roots of it so readily when it is in ear, and beginning to fill. On light land, he has sometimes observed the grain make no farther progress towards perfection, after a high wind at this period, which he presumes is principally owing to the roots being loosened, the ascension of nutriment to the ear being thereby prevented.

Mr Robertson of Ladykirk is of opinion, that the propriety of drilling beans, turnips, and potatoes, cannot be doubted, and that the more labour and hoeing bestowed on the bean and turnip crops, with judgment, and in dry weather, the better will be the returns. He also thinks, that drilling is of great use to grass seeds, for when the ground is rich, if sown broad-cast, the corn is apt to lodge, and to destroy the young plant. In regard to potatoes, Mr John Shirreff remarks, that, if the soil continues to be stirred, and the fibres which nourish the plants are continually disturbed, the stems will be puny, and the bulbs few and small. Potatoes should not be disturbed after being considerably advanced. Any annuals which may appear, should be drawn by the hand. Mr Robertson observes, that drilled crops of white corns are less apt to be beat down in wet seasons. It is contended on the other hand, that grain in drills, is more liable to be shaken than the broad-cast.

It is remarked, from the highest authority in the Carse

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\* It is a great advantage, as Mr John Shirreff remarks, to be able to regulate *this hold* of the ground, and to give all the seed at the same time the same hold. This advantage drilling affords; whereas, in the broad-cast mode, the seed must be deposited at very irregular depths; and as there can only be one *best* depth, all others must be faulty.

of Gowrie, that the culture of white corn crops by the drill, might be a beneficial mode of husbandry in that valuable district, as it would be the means of extirpating the growth of annual weeds, which are so destructive to the spring crops in the Carse, particularly the beans, the peas, and the oats sown early upon well frosted land, which are often rendered not half a crop by the growth of wild mustard.

Mr Rennie of Oxwell Mains, in East Lothian, states, in a recent communication, that he has entirely given up the drill system, as he conceives it by no means necessary for wheat sown in the autumn, and the spring-sown wheat, when drilled, takes at least ten days longer than the broadcast in ripening, which is a great loss in so uncertain a climate. The reason of its being so behind the broadcast is this; the hand-hoeing unavoidably cuts the plants, which causes longer time in tiltering, and the space necessary for the hoe, at least 12 inches, is so very broad for wheat, that the wind makes it often straggle and fall down, which keeps it from the influence of the sun, makes the grain coarse, and not so plump. The additional expence of pulling the weeds with the hand, in the broadcast system, he thinks does not exceed 5s. or 7s. the acre, more than when drilled; and when it is considered, that the ripening takes place so much sooner, and that the grain is of better quality, there is no comparison to be drawn between the different modes of sowing. Wheat, sown in autumn, requires little or no hand-weeding, the frost having the effect of suppressing weeds. On the other hand, Mr Hume of East Barns informs me, that he finds the drill husbandry greatly preferable for white crops. He has, this year, (*an.* 1813), all his spring crops drilled, also some of his winter wheat, and in his opinion the produce will be from two to three bolls *per* Scotch acre better, than if they had been broad-cast, which is visible

by the head-ridges, which have not been drilled. He drills at the width of ten inches apart, and gives three firlots of seed, either of oats or wheat, *per* Scotch acre. He does not think that wider intervals would answer.

An intelligent farmer near Arbroath, (Mr Rennie of Kinblethmont), states it as his opinion, that the drill system ought to be adopted, wherever turnips, potatoes, beans, or even peas, are sown; the intervals not less than twenty-seven inches, regularly horse-hoed, and the rows hand-weeded by women; which, if properly executed, leaves the ground in as good order as if it had undergone a naked fallow. None of the above-mentioned crops can be cultivated to advantage broad-cast; for in case of its failure, the ground is sure to be left in a wretched state indeed. In case of the soil being light, and much infested with annual weeds, the drill system may with great propriety be adopted with wheat, barley, and oats; but in that case the intervals should not exceed from nine to twelve inches, to be either hand-hoed, or done with a machine made for the purpose. The seed to be deposited by a sowing-machine, and the grass-seeds covered in with the last hoeing, which answers perfectly well.

An account of a new mode of drilling beans, on light soils, by T. A. Knight, Esq., and a new system of cultivating corn crops in drills, by Mr Beattie of Moffat, will be given in the Appendix.\*

The following, on the whole, seems to be the result that may be drawn from this important discussion.

That turnips ought to be drilled in all cases. Indeed, as Mr Shirreff remarks, the greater facility afforded by the drill mode of culture, of simplifying and expediting hand-labour, the more regular and correct adjustment of the

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\* See the Appendix, Numbers XXVI and XXVII.

number of plants to be left on a given surface; and the more equable admission and circulation of air among the plants in the drilled, than in the broad-cast mode of culture, gives the former a decided preference.

That potatoes should be in drills, but should not be disturbed by the plough after being considerably advanced.

That drilling carrots is advisable, more especially where there is not a great depth of soil.

That beans should be drilled, not only on light and loamy soils, but also on harsh, strong, and stubborn clays, otherwise they would in a manner be excluded from a soil, which cannot be profitably cultivated without them.

That peas ought to be drilled in dry soils and climates, more especially where the object is to clean the land; and though in clays, if the land is clean, sowing broad-cast is adopted by some, yet even there drilling is preferable.

That autumn or winter-sown wheat may be cultivated broad-cast, but that spring-sown crops, whether wheat, barley, or oats, are most likely to be productive upon light soils, where annual weeds abound, when cultivated in drills.\*

2. In a precarious climate, it is necessary, not only to cultivate early sorts of grain, but to sow early, in order to secure, if possible, an early harvest. This is particularly the case with oats upon strong and wet soils. They should be sown, therefore, as soon as the season answers, and the land is in good order to receive the seed, at least any time after the first of March. It is of advantage to sow even light soils early, that the crop may get forward, before the drought sets in.

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\* It may be proper at the same time to observe, that in several districts in England, particularly in some parts of Norfolk and Suffolk, they carry their ideas in favour of the drilling system, in so far as regards crops of grain, still farther.

3. As to a stale or a recent furrow, Mr Brown of Mar-  
kle is of opinion, that a stale furrow is best for corn crops,  
but that turnips, and other green crops, should be sown as  
speedily after the land is ploughed as possible. With regard  
to wheat after fallow, he always wishes that the ground  
should remain unsown, for a fortnight after the last plough-  
ing is given, so that it may get into a consolidated state,  
and be able to stand the harrowing process, without being  
too much subdued. But such operations must, in a great de-  
gree, be regulated by the weather, it being often necessary  
to sow the ground as fast as it is ploughed. It is a com-  
mon custom, when bean stubbles are to be sown with  
wheat, to plough in the forenoon, and sow in the after-  
noon, otherwise a season would often be altogether lost. It  
is in vain to say, that land ought not to be sown in an im-  
proper state. Farmers are obliged to do many things they  
do not like, owing to unfavourable seasons. They can-  
not have in their possession, or cannot always procure for  
hire, a sufficient strength of men and horses, to do every  
thing they like, more especially when the soil is of a strong  
nature, or even a greasy loam. But, those who are of opi-  
nion, that a recent furrow may be used with propriety,  
for crops in general, admit, that old sward or turf, often  
requires frost, before it can be harrowed with effect, and  
that land must be ploughed in many instances, at a sea-  
son when it cannot be sown. Whenever land turns up in  
any degree wet after turnips or beans, it is always the  
better of frost to meliorate and melt the furrows, which  
sometimes turn up whole and entire.

4. I am informed by an experienced farmer, that old  
wheat, *if kept in the stack unthreshed till wanted*, is greatly  
superior to new seed. The former springs immediately  
when sown, whereas the latter will not vegetate well, till  
it gets rain, which may not happen for some time, more

especially if the wheat is sown early. There is reason also to believe, that old seed wheat, is not so liable to the smut, as new seed, and that it produces straw of a stronger quality, and not so apt to lodge. Many intelligent farmers, however, doubt these advantages, and contend, that keeping old seed in the straw, must occasion a loss of at least 25 *per cent.* on the quantity kept.

5. The plan of kiln-drying seed wheat has been already alluded to, (see p. 260), and the suggestion of such a system, has led to some important observations from Mr Walker of Mellendean. He remarks, that having frequently lost his crop by getting kiln-dried wheat from the London market, he thinks that such an operation should be adopted with the greatest caution. He is persuaded, at the same time, that if care is bestowed on the ordinary way of pickling, there is no surer remedy against smut. For several years, he has always pickled as much as will sow a field, a day or two before he begins to sow, and has often, when bad weather came on, kept it for some time in that state, without its being injured; he is convinced, indeed, that unless the wheat has full time to dry, before sowing, the cure is not completed. He has long been in the practice of sowing considerable quantities of wheat, both in autumn and spring, and was led to draw this conclusion, from having often observed, in his wheat fields, a few ridges alternately clean and smutted, and he knew of no difference that had taken place in the pickling, on the contrary, he had attended to that operation himself, and sent the wheat to the field in quantities of one, two, or three bolls at a time, as wanted by the sowers. He could find no reason for a part of the crop being clean and a part smutted, but that a part of the seed had been used too soon after pickling. This led him to make the experiment of preparing a whole day's sowing a day be-

fore it was used; and he can only say, that since he begun that practice, which he has almost invariably followed, he has never been troubled with smut. It is proper to observe, that the wheat must have as much lime put upon it, as soon as it comes out of the pickling tub, as will dry it quickly; for if it is allowed to continue long wet, the germinating power will be altogether destroyed. It is remarked, however, by some farmers of considerable experience, that where urine is used, there is an absolute necessity of using the seed immediately.\* Indeed, instances might be quoted, of a total loss being sustained, where wheat, pickled with urine, was allowed to remain for a few hours unsown.

It is proper here to observe, that so important an operation as the pickling of wheat, ought not to be done in a slovenly manner, (merely sprinkling a heap with urine, and then drying it with lime), but should be performed with great care. 1. The wheat, after being thoroughly dressed, should be washed in clean water, and all the weak pickles skimmed off, until the water comes off without taint, and no more grains rise to the surface upon stirring; 2. The wheat should be put into a vessel containing stale urine, (which is the best steep), or sea-water, or water impregnated with salt, and skimmed again; and, 3. It should be dried with quicklime, and the sooner it is sown after the better.

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\* Mr John Shirreff observes, that if wheat has been pickled with *stale* chamber-ley, dried with quicklime, and put close together, to lie for a day, not a grain will vegetate. It ought to be spread abroad, as thin as possible, to dry and get air. Urine, when well fermented, will dissolve bones, and must therefore be extremely injurious to the germinating powers of wheat.

6. Mr Laing of Campend is of opinion, that farmers, in general, do not pay that attention that is necessary to a change of seed. They are convinced of its utility, but are too apt to think that changing from a strong to a light soil, or the reverse, is sufficient, without paying much regard to the climate. But he has learnt from experience, that it is not only necessary to change from a different soil, but also from a better or earlier climate, to a worse, at least in regard to wheat, oats, barley, beans, and peas. To ascertain that point, he has sown English seed wheat from London with some of his own, and it was always earlier by several days. He has likewise sown seed wheat, equal in quality to his own, from a situation where the climate is about ten days later than the farm he occupies, and it was nearly a week later than his own seed, sown at the same time. In regard to potatoes, it is quite the reverse, as it is perfectly well ascertained, that changing seed from a late to an early climate, is a complete preventative against the curl. It is also ascertained, that in the neighbourhood of Edinburgh, where the curl prevails, that they can be planted for two years successively, without changing the seed, and will be free from the curl, provided they are planted about the first, or even second week in June, and taken up at the ordinary time, or planted at the ordinary time, and taken up before they are fully ripe. It is probable that potatoes intended for seed, and planted in either of these ways, will never curl, whether the seed is changed or not. As an experiment, Mr Laing has planted, this year, a few of his own seed, with the seed he had changed, the produce of which is for next year's planting, which will prove, next year, whether potatoes may be planted with safety, more than twice in succession, which he thinks will be of some importance,

as the produce of his own seed is often more productive than the changed.\*

In regard to changing the seed of grain crops, there is every reason to believe, (as will be more fully explained in the Appendix, on the diseases of wheat), that by procuring seed from foreign countries, in particular from the Cape of Good Hope, the mildew, and other distempers to which wheat is liable, might be prevented.

As to harrowing the ground, or rolling it, these operations, however important, are so well known, and so similar, according to the Scotch and English systems of husbandry, that it seems unnecessary to dwell upon them in this place.

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### SECT. VIII.—*Of Weeding.*

THE subject of Weeding has rarely been discussed with that attention which its importance merits; and it has been well observed by Mr Brown of Markle, that the most experienced farmers are puzzled, how to extirpate the various sorts of those noxious plants; for the same operations, which destroy one species of weeds, will sometimes encourage the growth of another.

The following observations on weeding, are principally extracted from the communications of that experienced farmer, and those of Mr Kerr, the intelligent reporter of the Berwickshire husbandry.

Weeds are either annual, which come to perfection

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\* Taking up the potatoes intended for seed *early*, effectually prevents the curl.

within the period of one year, carry seed, and then die ; or perennial, which continue in life for a number of years, propagate both by seed and root, and consequently are extremely difficult to eradicate.

To extirpate annual weeds, the process of drilling is strongly to be recommended. That practice is already established in Scotland, in so far as regards turnips, potatoes, and beans, and materially tends to keep those crops clear from weeds ; but it should also be extended to every species of crop sown in spring, as wheat, barley, and oats, for spring culture is favourable to the growth of annuals, more especially when the land is dunged for a crop of grain, or when the preceding crops consist of turnips fed by sheep, and the ground is afterwards ploughed so deep, as to raise the seed of annual weeds, which had not been exposed to the turnip culture, and the hoeings which accompany it. In such cases, the drill husbandry may be introduced with much propriety. When the rows are of about 12 inches from each other, which is considered to be a proper distance in drilling corn, according to the present practice, there is space sufficient for admitting the hand-hoe, which readily eradicates the annual weeds as soon as they appear, before they become hurtful, or shed their seeds. An experiment took place a few years ago, upon a field of good land, which had frequently suffered from an overflow of annual weeds. The greater part of the field was sown in drills, and the rest in broad-cast, so that the extent of the improvement might be ascertained. The drilled part yielded a full crop, but the broad-cast was indifferent, being, as usual, over-run with annuals. The deficiency of the latter to the former was as nine is to fifteen, and the drilled part, (as might be expected), has ever since been in better condition than the broad-cast part, though under the same management since it was drilled.

They seem to have paid more attention formerly, at least in some parts of Scotland, to the extirpation of annual weeds, than is thought of at present. It is recorded, that an intelligent landlord, Sir William Grierson, was accustomed to hold *Goul*, (*Chrysanthemum*) courts, for the express purpose of fining the farmers, on whose growing crop three heads, or upwards, of that weed was found.\* Such a practice, if generally adopted, would soon extirpate annual weeds.

In regard to perennial, or root-weeds, a summer-fallow is the most effectual remedy. By turning over the ground frequently whilst in a dry state, without making the surface suddenly fine, drought is admitted, so that the root-weeds do not readily grow again, hence they become weak and sickly. But though they appear dry and shrivelled, knot-grass, dock-weeds, and many other perennial roots, revive upon the return of moisture, after even having appeared to be dead. The most effectual method, therefore, is to gather all such roots carefully by the hand. After being deposited in a large heap, and becoming corrupted, such roots make excellent composts, when mixed up with hot lime. Annual weeds, arising from seeds that have lain for time immemorial in the soil, are, on the other hand, best destroyed by retaining the moisture, which is secured by harrowing soon after the plough, thereby keeping the mould as fine and pliable as possible. Such seeds as are within reach of the atmosphere, soon vegetate in so favourable a situation. The young plants are destroyed by fresh ploughings, and harrowings, from which new crops of weeds spring up, and are destroyed as before.

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\* Statistical Account of Scotland, vol. ii. p. 4.—(Parish of Torthorwald).

Mr Kerr observes, that in land that is much infested with annual weeds, an industrious application of hand-weeding, combined with well-wrought fallows or fallow crops, according to the nature of the soil, and the farther aid of drilled crops of grain, will do a great deal towards a cure in the first course of rotation, and will render the task comparatively easy, during the remainder of the occupancy. On this subject, there is an old rural proverb, which ought to be held in remembrance by every husbandman :—*One year's seeding causes seven years weeding*

Besides couch, or twitch, which can hardly be sufficiently extirpated without a fallow, there are some descriptions of weeds which require peculiar attention, as, 1. Wild-mustard, and other plants of a similar description; 2. Furze and broom; 3. Docks; 4. Thistles; 5. Briers and Brambles; and, 6. Tussilago. The farmer also runs a great risk of introducing weeds, the seeds of which are often mixed with the clover, and other grasses.

1. It is almost incredible how long seeds of an oily quality, as those of wild-mustard, wild-radish, wild-marygold, &c., after remaining in the ground for many years, will vegetate, and when acted upon by moisture, the warmth of the sun, and the force of manure, become strong plants. Soil dug even from the bottom of deep ditches, will produce them. The proper mode of extirpating such weeds, is by pulling them when young, the expence of which, it is said, may be repaid by giving them to cattle, by whom they will be consumed when they are young.

2. The seeds of furze, or whins, are likewise of an oily description, and will lurk for many years under the surface uncorrupted, and will vegetate in great numbers after the land is again laid down to grass. A most intelligent correspondent informs me, that he has seen ground, originally a field of broom, which had been in tillage for thirty years,

yet when fallowed, limed, and dunged, and sown with wheat, on the wheat being cut, the young broom was found to be as thick on the ground as the wheat stubble. This was probably owing to the fallow, which turned up soil containing these seeds, which till then had been buried below the vegetative influences of the sun and air. In this case, a very moderate attention to have the seedling plants pulled up by the hand, in the first and second year of the lay, will secure the land from again running wild, although kept in grass for a good many years. This operation, however, must always be performed when the soil is saturated with moisture, as then only can the roots of these shrubs be pulled up without breaking. In every subsequent rotation, at least for a good many years, the same attentions must be renewed, to eradicate the successive crops, which will arise from the dormant seeds remaining in the ground.

3. Where docks are very numerous, either among grain crops, or in cultivated herbage reserved for hay, these ought to be pulled up by hand after heavy rains, when the soil is soft enough to allow their long tap-roots to be easily pulled without breaking, and before the seeds of these plants approach towards ripeness.

4. In many parts of Scotland, the only mode adopted of clearing the crop of thistles, is by cutting them close over to the ground, by means of a very simple implement, called a weed-hook; and even this is performed in rather a careless and superficial manner, perhaps at the expence of a shilling, or less, *per acre*. But in other districts, more especially the south-western counties, instead of the weed-hook, the weeders are provided with a more effective implement, a pair of forceps, or nippers, with two long handles, by which the thistles are effectually pulled up by the roots.

5. The extirpation of briars and brambles from arable land, is attended with a little more trouble, as their vivacious roots are placed below the operation of the plough, and will not pull up. To get rid of them, it is necessary to dig them out with great care.

6. There is no perennial weed more apt to elude the vigilance of the agriculturist, than tussilago, not only because the seeds of this plant comes to maturity before the leaves expand, (hence it was anciently called *Filius ante Patrem*), but from the seeds ripening so early in the spring, they are not unusually shaken, before the grounds have got the second furrow. This is mocking the toils of the farmer, even in the year of his fallow ; for should the whole roots of the old plants be afterwards extirpated, they have, by depositing their seeds, made sure of the succession in their own family. The industrious farmer, not aware of this two-fold attack of the enemy, wonders from what quarter he made his approach. If, therefore, the second furrow cannot be accomplished in time, it is prudent to send hoers, two or three upon every ridge, and carefully cut up such plants, so that they may be prevented from dropping their seeds, till they can be destroyed effectually by the plough.

But the best time for destroying tussilago is in the months of September and October, after the corns are cut, at which season the plants are at their full growth, and easily discovered. The method then to be used is, to pull up and carry off every stock or root that can be laid hold of ; and it will be observed, by inspecting the roots at about an inch below the surface, that a number of buds, about the size of a pea, spring from that part of the root, which flowering, afterwards produce fresh seed. Now, if these are allowed to stand till next spring, they will flower and shed their seeds, in spite of every possible at-

tention, the flowers coming out early in April, according to the season; so that it is impracticable to prevent their increase by any other method than the one suggested. If this plan, however, is persevered in for a few years, success is indisputable; though it must be remarked, that much depends upon performing the operation of pulling, as early as the corns are cut; for if delayed any length of time, the leaves wither and fall off, after which the roots cannot easily be discovered. If the weather is moist, there will be little difficulty in pulling up the roots to a sufficient depth; but should it be dry, or the ground hard, it is proper to furnish the pullers with a small piece of iron, split at the one end, like the toes of a hammer, and about ten inches long, to enable them to get the root up to the required depth. A few boys or girls, under the direction of a careful overseer, will execute this work at a trifling expence; and care must be taken, that all the roots so pulled, be carried off and destroyed, for if allowed to remain at the sides of stone walls or hedges, they will flower in the succeeding spring, and shed their seeds; which, being of a winged description, will fly about the field in all directions. Where land is much infested with this pernicious weed, it is proper to examine it in the spring months, lest any of the stalks should have escaped in autumn; and in this way, by attention and perseverance, ultimate success may be relied on.

7. There is likewise reason to apprehend, that much trouble arises to the agriculturist, from inattention to the choice of grass seeds. It not uncommonly happens, that the seeds of couch, knot-grass, &c. are mixed with rye-grass, and being nearly of the same size, shape, and colour, pass unobserved, and are thereby introduced into fields, which have been cleaned in the most careful manner. This is an opinion in which most people will concur, and the

truth of which has been proved by experiment. Some years ago, a farmer raised an excellent kind of rye-grass from his garden walks. These walks, being always kept short, had not a single seed dropped on them for twenty years, of course, the produce was purely perennial, and free from every adventitious mixture. This valuable grass was almost an evergreen, having the peculiar qualities of being both earlier and later than other grasses. In order to give it a fair trial, it was sown upon one half of a field, the other half of which was seeded with the best common rye-grass that could be procured, two ridges of each sort alternately. While in pasture, the ridges sown with the fine seed, were so much of a darker green, as to make the field assume a striped appearance. But since the field has been two years in tillage, it is quite easy to observe, that the ridges which were sown with the best seed, are much cleaner than the others, though the common seed was selected with a good deal of attention. This plainly shews, that seed can hardly be procured in the seed-shops, free from adulteration; for if one pickle of such impure seed is found amongst five hundred, it is sufficient to pollute a well-dressed field; and if a person of judgment chuses to go into seed-shops in the sowing season, he will find a number of such seeds in a sample, capable of being contained in a snuff-box of ordinary dimensions.

It must, on the whole, be admitted, that the process of weeding, is too much neglected in Scotland, even in districts which are in other respects exceedingly well cultivated. Mr Kerr justly observes, that extensive tracts of excellent arable land, capable of bearing heavy crops of grain and cultivated herbage, are to be seen in many places, disgracefully overwhelmed by vast quantities of weeds, especially by varieties of rape and mustard, besides other more humble plants, as chick-weed, yarrow, fat-hen, bind-

weed, together with different kinds of thistles and other plants; by all which the grain crops are deprived of a large proportion of the moisture and nourishment they would otherwise derive from the soil, to the manifest and large diminution of useful produce, both in regard to quantity and quality of grain and straw. Were husbandmen fully aware of the great injury they sustain from a profusion of weeds, and the profitable advantages which must necessarily accrue to them, by the extirpation of these robbers of the soil, both by the amelioration of the individual crop among which they grow, and by preventing them from maturing and shedding their seeds to injure future crops, they would surely see the propriety, of exerting their own superintending industry, and of sparing no moderate expence, to cure the evil. It is not the operation only of the best-worked fallow or fallow crop, once in a rotation of four or six years, that will free land that is much infested by annual weeds, from this pertinacious host of enemies to the profitable crops. The seeds of these plants, when allowed to ripen, and scatter themselves over the surface of arable land, are known to remain for many years torpid within the soil, till circumstances, favourable to their growth, call them into action.

No husbandman would dream of permitting the live stock of his neighbours, to feed perpetually in his pastures, as the diminution of food to his own stock, by that circumstance, would be perfectly obvious. A little serious consideration might surely convince any rational being, that the mischievous effects of a multitude of weeds, among crops of any kind, are perfectly analogous; for a given extent of land, is only able to bring a certain limited quantity of vegetable growth to maturity, proportioned to its staple or natural fertility, and to the manure which it contains.

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SECT. IX.—*Of harvesting Grain, and preparing it for the Miller.*

THIS is a point on which it is not proposed to insist at any considerable length, but merely to detail any peculiarities in the Husbandry of Scotland, in regard, 1. To cutting down ; 2. To carrying in ; or, 3. To stacking the crop ; 4. The management of stubbles ; and, 5. How wheat, injured by a bad harvest, is prepared for use.

1. In Scotland, the crop is almost universally cut down by the sickle or hook, the scythe being very rarely used ; and notwithstanding the liberal premiums offered by a respectable and public-spirited institution, the Dalkeith Farming Society, no reaping machine has yet been invented, that will answer the object they had in view. Many suppose, that it is almost necessary to cut down corn with the sickle, if threshing-mills are in use ; because, where these machines are employed, the grain must either be regularly placed and bound, or it must pass twice through the mill. But that intelligent border farmer, (Mr George Culley), informs me, that he mows his barley almost every year, except what is lodged ; and that he finds no difficulty in threshing it by the threshing-mill, passing it only once through the machine.\* The men mow the

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\* On this head, that experienced and intelligent farmer, Mr John Shirreff, observes, that more ears would probably escape unthreshed,

corn in the same manner as if they were mowing grass for hay; but by using what they call a bow, fixed at the heel of the scythe, they are enabled to lay the barley almost as straight, as if cut with the sickle, so as to tie it up into sheaves very neatly. He considers this as the cheapest, and in every respect the completest mode of harvesting barley.

To many of the more fertile districts, great numbers of Highlanders, both male and female, annually resort, to reap the crops, and receive a certain sum *per* day, and their victuals, for the work they perform. In the Carse of Gowrie, the harvest was formerly performed by men and women hired expressly for that purpose; the men at a guinea, and the women at 15 s. for the harvest; during which time they got a breakfast, a dinner of bread and beer, and a small quantity of oatmeal for supper. At that time, the harvest used to cost about 5 s. *per* acre, including all expences. Some time after that, the harvest wages rose to 30 s. for the men, and 20 s. for the women, varying, as the farmer and they could agree; but the expence altered according to the price of meal, and the length of the harvest, from a favourable season, or the contrary, and it has been as high as 9 s. or 10 s. *per* acre. About fifteen or sixteen years ago, some men came to the Carse as contractors, and agreed to cut down the crops at a certain sum *per* acre, but that plan did not continue long.

About six years ago, another practice took place in that district, which continues to this day. It is called *threaving*,

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than would pay the difference between cutting by the scythe and the sickle. At the same time, he admits, that a great benefit arises from mowing grain crops, by the additional quantity of straw obtained. That advantage, however, may be got by mowing the stubble.

and now almost universally prevails. By this plan, the reapers are paid in money, without victuals, so much for every threave they cut down. For a threave of wheat, consisting of twenty-eight sheaves, each sheaf measuring thirty inches round, they receive 4 d.; and for a threave of barley, oats, or peas, of twenty-four sheaves, each thirty inches round, 3 d. Mr John Shirreff remarks, that this is certainly, on the whole, the fairest mode of paying reapers, the reward being exactly in the ratio of the work done. It is evident, this can never be the case when a field is cut down either by the day, or the acre.

This mode of harvesting, has been found of great advantage to the country in general; for thus whole families, men, women, and children, obtain employment; they bring their provisions with them, remain in the field the whole day; the old teach the young to cut down; every one does something; and according to what they perform, they are paid. A hundred, or a hundred and fifty persons, young and old, may frequently be seen in a field at the same time, and besides the advantage of getting such a quantity of ripe corn cut down in a day, it is an excellent school to fill the whole neighbourhood with good reapers or shearers.\*

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\* Communication from George Paterson, Esq. of Castle-Huntly. Another respectable correspondent from that district observes, that the growing crops of corn are now cut down by the threave. The wheat-threave consists of twenty-eight sheaves, each sheaf, with him, measuring thirty-six inches in girth, at the band; for cutting and binding of which is paid, in his neighbourhood, 6 d. *per* threave. The barley, oats, and peas, or bean threave, consists of twenty-four sheaves, of thirty inches girth, for cutting and binding of which is paid 4 d. each threave. These dimensions of the sheaves are varied according to the fancy of the farmer, and the price is either more or less according as the size of the sheaf is increased or diminished. Hence what may cost 6 d. and 4 d. in one part of the district,

Mr Blaikie has sent me the following detailed account, of the mode of harvesting in Roxburghshire, and part of Berwick and Selkirk shires. The reapers are mostly bespoke, or hired in the public markets, for that purpose, in the month of August. They are engaged for the harvest, which, at an average, continues about four weeks, but they are still paid for every day according to the above wages. The now common wages are, women, 12 s. 6 d. *per* week, men 15 s. with victuals. Two men and four women, with a bindster, make what is technically called, a Band-wind. These, upon a field where the corn is not strong, and lying fair to the sickle, will cut two English acres, and sometimes two Scotch acres *per* day. But where the corn is cross-lodged, and very strong, they will not do more than one acre and a half English. Two English acres, however, *per* day, may be an average when the work is properly performed. I understand, however, that corn in Roxburghshire is not always cut so near the ground as in some other districts.

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may be charged only 4 d. and 3 d. in another. On this subject, Mr John Shirreff remarks, that it is not material to the reaper, unless in regard to the time required for making the bands and the additional sheaves, what the circumference of these sheaves are, provided the same number of sheaves is reckoned to a threave, and *the price paid in the ratio of the squares of their diameters*. As to the sums paid, circles being to each other as the squares of their diameters, if 900, the square of thirty inches costs 4 d.; so 1296, the square of thirty-six, should cost 5.648, &c. &c. Where 6 d. therefore is paid, a threave costs more in proportion than it ought to do.



On the expence of reaping, Mr Brown of Markle observes, that the above estimate seems defective, as it does not include the maintenance of reapers in bad weather, (which often amounts to a considerable sum), nor the expence of salt for seasoning their porridge, and fuel for cooking it, nor any thing on account of blankets in which the reapers sleep, together with the wages and victuals of the overseer who attends upon them; all which articles will not a little increase Mr Blaikie's estimate, even admitting that three reapers are capable of cutting, through the whole harvest, an English acre *per* day, which can only be the case in very favourable seasons, or when the crop is light, and below a medium. In short, the reaping process, taking every expence into consideration, cannot be duly and sufficiently executed, in the more improved districts of the kingdom, where wheat is extensively cultivated, and the crops are weighty, under from fifteen to eighteen shillings *per* English acre; and when it is well done at either of these rates, the farmer may be satisfied.

In order to train up reapers or shearers, an intelligent farmer, Mr Mitchell of Balquharn, puts four or five, according to their ability, on a separate ridge, and gives them, as an awkward squad, a sum in proportion to three on a common ridge. At the same time, it is, in general, a good rule, to have as few reapers as possible on a ridge, when they understand their business, for the more there are, the less work will be done. The lazy and idle, as Mr John Shirreff remarks, will take every opportunity of saving themselves, and it will be difficult to ascertain who is to blame.

Attentive farmers take particular care to cut the crop very low; for by high cutting, besides the unavoidable waste, a great deal of manure is lost. By attending to this, and converting the straw into dung at a proper season, a

sufficient quantity may be procured, to raise good crops of turnips, the greatest part of which being eat up on the ground by sheep, insures a succession of good crops of grain, until another crop of turnips is taken.

2. Grain is sometimes carried in by single-horse, but generally by two-horse carts, to which frames are fixed, in order that the cart may convey a greater quantity of grain at a time. Carts, in this way, will easily carry at once, from ten to twenty stooks, according to the size of the sheaves. In a note will be found the different modes of making and fixing these frames,\* which are found highly advantageous.

It is certain that carts are more easily managed than waggons; and that by using them, the carrying of corn in harvest goes on with the greatest expedition. The ordinary mode of unloading these carts is, for the driver to stand upon the top of his load, and fork the sheaves up to the builder, in which way the sheaves are kept more secure

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\* There are three different modes of fitting up the carts for harvesting grain or carrying hay. 1. By the first, the limbers or shafts are fixed together by cross spars, and the upper framing mortised into the limbers. 2. Another method is to fix the limbers together by cross spars, but the upper framing is fixed together separate from the limbers, and fixed upon them by screws. This frame will cost from L. 2 to L. 3, according to the quality of materials, and goodness of the workmanship. 3. A frame, called a hay-top, is occasionally fixed upon the common cart, either with small ropes or iron chains. These frames will cost from 15 s. to L. 1, 10 s. or L. 1, 15 s., according to the materials and quantity of iron-bolts made use of in fixing them together. Both these plans are thought preferable to the first, because the shafts are not so much weakened by so many mortises cut in them, besides the advantage of the upper framing being easily taken off, so that the cart can, at any time, be made use of for carrying wood, large stones, &c.—Communication from Mr Andrew Gray.

and firm than if the whole load was upset, and left to be forked by another person, as has been recommended.

3. It is well known, that the corn in Scotland, is universally kept in stacks, with the exception of the celebrated barns at Inverary, and Roseneath, where the Duke of Argyle is obliged, from the unceasing wetness of the climate, not only to preserve, but actually to dry his corn, in large buildings erected for that special purpose. In Argyleshire, and other western districts, buildings, on a smaller scale, for the same purpose, are also constructed.

At Lord Haddington's seat of Tynningham, the stacks are built on stone pillars, which is found to be a very advantageous system. It takes nine pillars with capes to a stack. The price of these depends very much on the convenience of getting the stones. There they can be quarried, carted home, wrought, and put up, for about 3 s. each. It will require about twenty feet of timber to make the frame that goes on the pillars; the price of which also depends on the situation, and whether it can be got by short carriage. From the present high price of timber even there, where wood is so abundant, including every expence, a complete set of nine pillars, and the timber necessary for a stack, cannot cost less than L. 3. The advantages resulting from this method, when the object is, to keep the stack free from vermin, may be about two bolls in thirty; but in a wet season, such as the year 1809, it is found very useful for drying the corn, when not put into the stack in the best condition, as the pillars allow a free circulation of the air under, and the corn is not injured by imbibing moisture, as it must necessarily be, when set down on the ground in a wet state.\*

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\* Communication from Mr David Buist, overseer at Tynningham.

Near Alloa, they have invented cast-iron pillars for stacks, (an engraving of which is annexed), which seems to be an useful invention where stone cannot be had. These pillars are two and a half feet long, and the round cape or bonnet at the top, as well as the foundation, is one foot in diameter. After levelling the ground intended for the stack, so that all the seven pillars may stand plumb or perpendicular, and level on the top, they are placed on the level surface, and require neither building nor flag. Being placed in this way, they can be removed with very little trouble or expence. Vermin have also no way of getting up cast-iron pillars of the above description; and neither rats nor mice have been found in any stack properly standing upon cast-iron pillars. The price of seven pillars is 50s. and the frame, which is made of the very coarsest of timber, may be valued, (including workmanship and nails), at 8 s.; so that one stack costs 58 s.\*

There is another invention, which I believe is peculiar to Scotland, called *bosses*, the nature of which the annexed engraving will explain. These, with cast-iron pillars, are admirably calculated for harvesting beans in wet seasons. The process is thus described. A triangle is first erected on the middle of the frame, which forms a boss of about three feet wide; railing must be nailed across the boss so close as to preserve the sheaves from falling into it; but

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\* Communication from Mr John Laing, overseer at Tullibody. I was informed by the late Mr George Culley, that on his side of the Tweed, they prefer oblong stacks to round ones, because they can add one eke or *leet* (as they are provincially called) to another, always to be set east to west, for he has seen them blow over, when set north to south. He was also of opinion, that oblong frames are simpler made, and cheaper-timbered, than round ones. But they do not seem to be so well calculated for exposed situations.

when raling is not at hand, a strong straw rope is commonly used in its stead. After the builder has reached the top of the boss, he places therein a sack filled with straw, which, when he builds round, he pulls up until he reaches the top of the stack; so that by the vent left by the sack, the air reaches even to the top of the stack. As to the question, how soon beans can be put in, by means of bosses, that depends upon what state the beans were in when cut. It is necessary, therefore, to mention three different cases in which beans are cut: First, before either leaves or pods have changed their colour; if cut in this green state, they will require a long time, especially in a bad season, even with bosses, and it is hardly practicable to preserve green cut beans, in any season, without them. Secondly, when above half of the pods have turned yellow, and part of the leaves have fallen off; when cut in this state, (which is thought much the best), they will require from seven to eight days with bosses, and fourteen without them, if the weather is dry. And, thirdly, when the pods have all turned blackish, and the leaves fallen off, in this state, three or four days may do with bosses, and seven or eight without them, provided no rain fall in the interval. On the whole, it may be affirmed, that beans, by this mode, may be harvested in half the usual time, and be preserved in much better condition. It is supposed that the beans grown upon strong clay, or carse land, require longer time to fit them for the stack, than those produced upon dry land.\*

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\* In a wet season, white grain is often stacked in the manner here recommended for beans, with this addition, (if the state of the grain seem to require it), of having vents left also across the stack in two opposite directions, at different heights. These afford a great additional circulation of air. Some make a vent in the middle of the stack, but very im-

Any plan that would tend so materially to improve our mode of harvesting beans and peas, (for the latter crop might be treated in the same manner), the culture of both of which is so desirable, is of the most essential consequence to Scottish husbandry.

A very simple but effectual mode of preserving beans in the stack, is to have two or three funnels as long as to reach near its centre, to communicate with a vacuity prepared by drawing up a sheaf of thatch while building. Each funnel has two ends, generally triangular, about eighteen inches each outside. These are covered with any sort of coarse timber on all sides, so as to prevent their being filled with the bean sheaves pressing into the opening. They may be placed at different heights from the bottom of the stack, and they will create such a suction as to keep both corn and straw safe.\*

4. As in Scotland, wheat and other grains are, in general, cut close to the ground, little or no stubble remains, that can be applied to any particular use. Sometimes, however, cattle and sheep are turned in, to eat the fallen ears, or any verdure that may happen to be on the ground. For this sole purpose, the stubbles must be proportionally the less useful, as the crop has been the better reaped and harvested, and as the land has been previously the more accurately cultivated and cleaned from weeds. Farmers will necessarily be careful not to admit live stock into stubbles, where the land has been sown up with clover and rye-grass, because the feet of horses and heavy cattle,

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properly leave no opening at either top or bottom.—Remark by Mr Church of Hitchill.

\* Mr John Shirreff explains the operation of the funnel, in the following manner. The air in the funnel, being heated by the evaporation from the raw beans, *ascends*, and is supplied by cool fresh air from below.

would do material injury, by leaving holes, in which water would collect in winter and spring, and because it might be of great detriment to the future crop, if these plants were cropped, close over before winter, by injuring the crowns of their roots, and by removing what shelter their previous growth might afford against frost.\* Some farmers, however, are of opinion, that when the clover and rye-grass are very rank, moderately pasturing them, in *dry weather*, early in autumn, will be of service to them, and the eatage is very valuable.

It may be proper to add, that it was the practice of the ancients, to burn their stubbles, which not only operated as a manure, but had a tendency to destroy the seeds of weeds.† It is recommended in one of the county reports, to gather the stubble, and to stack it, for the purpose of burning it, before turnip sowing, as a manure for that crop.‡ It would appear from the same report, that burning straw on the stubble is sometimes practised.

5. In regard to the management of wheat injured by a bad harvest, and preparing it for consumption, it is certain, that though wheat, as well as other grain, if put up when in proper condition, will keep better in a large than in a small stack; yet, in damp seasons, it will dry sooner in small stacks, and consequently will be sooner fit for grinding into flour and baking. Wheat that is stacked in a damp condition, should never be threshed sooner than the summer afterwards.

When wheat is sprouted, it improves much by being

\* See the General Report of Scotland, Chapter 7. Part 4. Sect. 1. § 16.

† See Virgil's Georgics, Lib. 1. verse 84; also Isaiah, Chapter 5. verse 24.

‡ See Lincolnshire Report, p. 268.

kept long in the straw, and mixed with sound old wheat. Good bread, in general, cannot be made without a mixture of old wheat, (unless the season has been uncommonly good), for at least two or three months after harvest. The old wheat absorbs the superabundant moisture in the new, and makes it bake dry. In common years, one-fifth part of old wheat is necessary till the month of March, for loaf-bread, but not so necessary for rolls.

Wheat, if not in good condition, is improved by kiln-drying. There are two kilns belonging to the corporation of bakers of Perth, for that sole purpose; but this does not render a mixture of old wheat unnecessary, although it improves the grain that was damp when threshed. The wheat should not be used until some time after it is kiln-dried. It will then improve the colour of the bread. It ought to be kiln-dried with great care, slow heat, and often turned.

The corporation of bakers at Perth, have a wooden tub for cleaning smutted wheat, which it does effectually in the course of three washings, however black it may have been. It resembles a potatoe-mill. The wheat is afterwards kiln-dried.

More attention on the part of the farmers, to the pickling of their seed wheat, might surely render such an operation unnecessary; and, to the honour of the improved districts, it may be stated, that smut is hardly known within their bounds.

It may not be improper to add, that formerly, and even within these twenty-seven years past, it was thought necessary to mix some English wheat with the Scotch, in baking bread of superior quality; but though Scotch wheat is inferior to the English, and will probably remain so, owing to a defective climate, yet wheat grown in the Carse of Gowrie or Strathern, and other northern districts, is so

much improved in quality, that such a mixture is no longer required, and the bread of Perth in particular, where those wheats are alone used, equals any in the united kingdom.

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### SECT. X.—*On Straw, its Value, and Uses.*

THIS is a subject that has not hitherto been so much attended to as its importance deserves.\* Though many useful observations on straw, are occasionally introduced in agricultural writings, and though its value, as the basis of future crops, is fully admitted by every intelligent farmer, yet I do not recollect to have seen the subject professedly treated of at any length; I hope, therefore, that it may be of some use to allot a section of this work for its discussion. It would require a whole chapter to go through the subject fully, but I shall endeavour, in this section, to compress the most important particulars connected with it, under the following heads:—1. The weight of straw produced on an average of the different crops of grain

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\* On this head it has been well observed by an intelligent agriculturist, the Rev. Dr Skene Keith, that whilst the value of corn is universally acknowledged, and duly appreciated, that of straw has either been totally disregarded, or but little attended to by many. It was a maxim of Sir William Trumbull's, secretary to King William the Third, "Take care of the pence, for the pounds will take care of themselves." In like manner, he says, it may be recommended to every farmer, even in the most fertile districts, to "*Take care of the straw,*" for, from the increasing population of the country, and the increasing value of that production, "*The corn will take care of itself.*"

and pulse, *per statute acre*; 2. The value of the different kinds of straw, in so far as that can be ascertained; and, 3. The various uses to which each kind of straw is applicable.

Although the agricultural practices of the more improved counties in Scotland, have been principally detailed in this work, yet as this subject is not only of great importance, but has hitherto been but imperfectly explained, it is proposed to discuss it at some length, and occasionally to mention the different practices both of England, and of the less cultivated districts of Scotland, where the information obtained seems to be material.

1.

*On the Weight of Straw produced by the different Crops,  
and the average Amount of the whole.*

The quantity of straw produced *per acre*, differs according to a variety of circumstances, as, 1. The species of grain, whether wheat, barley, oats, &c.; 2. The different kinds of the same grain,—for red oats produce less straw than Angus oats,\* &c.; 3. The season,—for in dry seasons the quantity is less than in the moist; 4. The soil,—for in fertile soils the straw is more abundant than in poor ones; 5. The season when the seed is sown,—for spring-sown wheat has less straw than the winter-sown; and, 6. The manner in which the straw is cut,—for an inch or two at

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\* Red oats, producing perhaps 7 quarters *per acre*, will often yield much less straw than Angus oats, producing only five quarters.

the root-end of the straw, makes a great addition to the dunghill.†

It is certainly desirable, however, notwithstanding these diversities, to be enabled to form *some general idea*, of the average produce, *in straw*, of each kind of grain, and the average weight produced by all the different crops. But owing to the little attention that has hitherto been paid to the subject, and the scantiness of authorities, the weight cannot be ascertained with the accuracy that could be wished, though it is probable that the following estimates are not far from the truth.

Mr Young informs me, that he has seen a calculation, from which it would appear, that the average produce, in straw, of all the different crops, stubble included, may be calculated at 1 ton 7 cwt. *per* English acre, but that is rejecting the weaker soils.

It is calculated by Mr Brown of Markle, that on an average of years, the produce of straw, in good land, and under tolerable management, will be nearly in the following proportion, *per* English acre :

				Stones.
Wheat,	-	-	-	160
Beans and peas,	-	-		130
Oats,	-	-	-	130
Barley,	-	-	-	100
			Total,	520

† Mr Middleton remarks, that it is the custom in Middlesex, to cut the crop close to the ground, which secures an increased quantity of straw, worth perhaps 7 s. *per* acre.—*Middlesex Report*, p. 172.

It is generally remarked, that there is more straw when the crop is cut down by the scythe, than by the sickle.

Or, at an average of these crops, 130 stone *per* acre, 22 lb. avoirdupois, *per* stone, in all, 2860 lbs. or 1 ton, 5 cwt. 2 quarters, and 4 lbs.

Mr Dudgeon of Prora calculates, that an English acre of good land, under proper management, will produce four carts of straw in the corn, and that the straw separately may weigh, *per* cart, 35 stoncs tron, or 140 stoncs in all, or 1 ton, 7½ cwt. *per* acre. This estimate, however, is only applicable to the more improved districts.

On the whole, therefore, it may be safely estimated, that on an average of years, well-cultivated and fertile soils, when the crop is carefully cut down, will annually produce, on the average of the crops above mentioned, and taking the average of the kingdom, 1 ton, 5 cwt. *per* English acre.

Rye is rarely cultivated in Scotland, but when that sort of crop is grown, the produce of straw is very great. Mr Brown of Markle informs me, that a few years ago, he had 3 Scotch acres of soft loam, under a crop of rye, the straw of which was of great length, and weighed fully 250 stoncs tron, of 22 lb. avoirdupois, each. This was ascertained at Haddington, when it was delivered to the contractor for the barracks, at 9 d. *per* stone. Reducing the above quantity into English weight and measure, the produce was nearly two tons *per* English acre.

## 2.

### *On the Value of the different Kinds of Straw.*

The intrinsic value of straw must vary materially, according to its feeding properties, the quantity of manure

into which it may be converted by littering, or its fitness to be employed as thatch, these being the chief uses to which it is applicable; but in general its price principally depends on its vicinity to large towns. It is only in situations where foreign manure can be procured easily, and at a cheaper rate than by converting the straw raised upon the farm into dung, that the sale of straw is ever permitted.\*

Straw is generally dearer in London and its neighbourhood, than in any other part of the kingdom. It is sold there by the load, which consists of 36 trusses, of 36 lbs. each, or 1296 lbs. in all. Two loads of wheat-straw, *per* acre, are reckoned a tolerable crop, the average price of which, was formerly from 25 to 40 s. *per* load, but it has since risen to L. 3, 12 s.† At Bath, during the winters of 1791 and 1792, wheat-straw was sold as dear as hay, and many innkeepers, from a principle of economy, used hay of a tolerable quality, instead of straw, as litter. In 1806,

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\* Baron Hepburn observes, that by the usage of East-Lothian, most of the farms in this respect are *steelbow*, that is to say, the straw of the last crop belongs to the landlord, and is left, after threshing, to him, or to the incoming tenant.

† Mr Middleton gives the following comparative estimate of the value of straw and corn in Middlesex, about the year 1796, before the late great increase in the price of grain :

	<i>Per</i> Bushel.
1. Wheat, at an average for many years, - -	L. 0 5 6
2. Straw, as sold at market in trusses, from each bushel of wheat, - - -	L. 0 2 7
3. Short straw and chaff, - - -	0 0 1
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 0 2 8
Consequently the entire value of wheat <i>per</i> bushel was	L. 0 8 2
Of this produce the straw formed above a third part.	

straw sold at Oxford, at from L. 2, 2s. to L. 4, 4s. *per load*, of 22½ cwt. The stubbles fetched only 2s. 6d. *per acre*.\*

In the vicinity of Edinburgh, it is calculated, that a boll or 4 bushels of wheat, produces a kemple of straw,† which, by the regulations of the Edinburgh market, should weigh only 15 stones; but the farmers generally give about 18 stones, for which they get from 13s. to 14s. *per kemple*, or at the rate of about 9d. *per stone*. The amount, consequently, may be stated at about L. 6, (calculating the straw at the rate of 160 stones) *per English acre*. Wheat-straw is principally used for litter. When threshed by the flail, being considered better for thatch, it fetches from 1s. to 2s. more *per kemple*.

The straw of beans and peas is seldom sold in Edinburgh, being applied by the farmers in that neighbourhood to feeding their own stock. It formerly fetched, when hay was scarce and dear, from 25s. to 27s. but at present is only worth about 18s. *per kemple*.

The value of oat straw is higher in the Edinburgh market than that of wheat, being reckoned more nutritious and palatable, both for cows and horses. It brings from 12s. to 15s. *per kemple*, or from 8d. to 9d. *per stone*. The crops are so weighty, that the produce, in straw, frequently amounts to above L. 7 *per English acre*; but from this the expence of carriage and marketing must be deducted.

Dr Skene Keith states that the value of straw in Aberdeenshire is now from L. 1 to L. 2 *per acre*, or from 2s. 6d.

\* Oxford Report, p. 153.

† This would require 35 five-ninths bushels of wheat, *per English acre*, (a crop not at all unusual in that neighbourhood), to produce 160 stones of straw.

to 5 s. *per* boll; but that, before the introduction of the turnip husbandry, it was extremely variable. In 1769, for example, a boll of oats, with fodder, cost 12 s., without fodder, 10 s., or only 2 s. less; but in 1770, a boll of oats, with straw, cost 20 s., and without the straw, only 12 s., or 8 s. less. In 1774, a boll of oats, in the straw, cost 16 s., and without the straw, 15 s., or only 1 s. less. But next year, viz. 1775, a boll of oats, with straw, cost 22 s. 6 d., without the straw, only 12 s. 6 d., or 10 s. less. This shews the great advantage of the turnip husbandry in a cattle-rearing country.

He remarks, at the same time, that though barley has the least weight of straw, it has a considerable proportion of chaff, and light corn.

Some calculations have been made of the comparative value of hay and straw. An English acre of hay will produce, on an average, about  $1\frac{1}{2}$  tons. It was formerly calculated that hay was worth double the price of straw, but owing to the variety of local circumstances, there is no fixed proportion between their prices. As a kind of average, however, the following calculations have been drawn up:

Hay, $1\frac{1}{2}$ ton, at 1 s. <i>per</i> stone, of 22 lb.	L. 7 13 0
Straw, $1\frac{1}{4}$ ton, 6 cwt. at 8 d. <i>per</i> do. do.	4 8 0
	<hr/>
Difference,	L. 2 2 5

But if the straw of wheat, oats, and barley, without including peas and beans, enter into the calculation, in equal proportions, they cannot be estimated, on an average, at more than 6 d. *per* stone, which gives an additional sum in favour of hay, to the amount of L. 1, 2 s., making the difference between the straw of these crops, and hay, L. 3,

7 s. *per* English acre, to which may be added, L. 1 *per* acre, for the after-math, or L. 4, 7 s. in all. The same land, however, besides the straw, if well manured, and properly cultivated, would produce 50 bushels of wheat, or 60 bushels of oats, which would do much more than compensate that difference, and the expences of its cultivation. Hence the comparison comes to be, not so much between hay and straw, as between grass and arable crops.

It is to be observed, on this head, that from November to March, the straw of oats, beans, and peas, and, in some districts, barley or bear, is, with an allowance of corn, the chief food of farm horses in Scotland; and thus supplying the place of hay, it is of nearly the same value to the farmer; and though hay will make an ox fat, which no quantity of straw will do, yet the question is not as to the relative fattening qualities of hay and straw, but whether straw may not be used, in some cases, with advantage, *as a substitute* for hay. Whatever may be the price of hay, it is proved, by the experience of the most intelligent farmers in Scotland, that bean and peas-straw, in particular, when properly harvested, is worth three-fourths of that price, any time between November and March, for feeding working horses and oxen, or for giving even to fattening cattle, mixed with richer food, at least at the commencement of that process.

As straw is rarely permitted to be sold, being usually employed in maintaining winter stock, Mr Brown of Markle remarks, that the real value of the article to the farmer is but inconsiderable, depending upon the quantity and the quality of the dung it produces. If 130 tron stones of straw can be manufactured into four double cart-loads of dung, (as is generally supposed), and if the dung be estimated at ten shillings *per* load, a price it is worth when properly manufactured, the value to the farmer, does not

much exceed 3 d. *per* stone, tron weight, of 22 lb. avoirdupois, or about L. 1, 12 s. *per* English acre: Nor was straw formerly reckoned of much value for feeding. Mr Brown states, that before turnips were generally cultivated, many farmers in East-Lothian, were in the habit of wintering cattle, of a moderate size, for dealers and others, charging only 15 s. *per* head, from the middle of October, to the first of May: and Mr Bailey of Chillingham, in Northumberland, informs me, that 20 s. for wintering, is still a common price in his neighbourhood.

So little is it thought necessary accurately to ascertain the value of straw, that in several cases it has been given by the outgoing, to the incoming tenant, as an equivalent for the expence of harvesting, threshing, and marketing the last crop.\* It is often thought insufficient to cover even that expence, and a farther abatement is allowed on the price of the grain. A farmer of Roxburghshire informs me, that in 1806, he sold the straw of a crop, consisting chiefly of oats, with a small proportion of barley, at 2 s. 6 d. for the straw of each boll, equal to  $7\frac{1}{2}$  Winchester bushels, he being at the expence of reaping, carting, and stacking, and the purchaser of threshing and marketing; so that the straw would cost him in all about 5 s. *per* boll of grain, or 40 s. *per* acre. The crop was estimated at 60 bushels *per* acre; the straw at about 125 stones, of 22 lbs. each, or  $1\frac{1}{4}$  ton, at which rate it only cost  $3\frac{3}{4}$  d. *per* stone. Had it only amounted to 100 stone, it would have cost but 5 d. a stone, at which price the purchaser would have been amply repaid in fodder and dung. In the same district,

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\* This can only take place, where the crop is not *steel-bow*; that is, where the straw belongs to the landlord or incoming tenant, which ought always to be the case.

hay did not fetch, at that time, more than from 8 d. to 9 d. *per* stone.

## 3.

*On the various Purposes to which Straw is applicable.*

These may be considered under the following general heads: 1. Feeding stock; 2. Litter; 3. Thatching; and, 4. Miscellaneous purposes.

1. *Feeding Stock.*

In former times, the supporting of stock was the great object to which straw was applied. Almost every blade was devoted to that purpose, and scarcely any left to litter the stalls. The husbandry of the celebrated Bakewell was then much commended, who used no straw for litter, but if he had more than his own cattle would consume, would rather take in those of his neighbour, to eat the straw for nothing, giving them the same attendance as his own, than use it for litter.\* No species of dung was then valued, that had not passed through the body of an animal; and if by littering, more muck was made, yet the dung of straw, when eaten, it was contended, was more profitable. Bakewell, however, after trying it for several years, was convinced by experience, that he had adopted an erroneous system, and, with his usual sagacity, he resolved to litter his stock amply, for the sake of dung, and not for the benefit of his cattle.† As people are too apt to run

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\* Farmer's Tour through the East of England, vol. i. p. 120.

† Annals of Agriculture, vol. vi. p. 487.

to extremes, the rage now is, to use the whole, or nearly the whole, as litter, and to give little, if any, of the straw to stock.

It is certain that nothing could be more injudicious, than the plan of feeding cattle solely upon straw, without the addition of hay, corn, or succulent food. It is justly observed upon this system, by Doctor Singer, that when the winter and spring were severe, and the cattle were fed on straw alone, they sometimes fell off so much, before the new grass made its appearance, that many of them died for the want of sufficient sustenance; and the rest were so much reduced in condition, that they could hardly stand, or were almost "*at the lifting,*" as the farmers said. It required also, two or three months of good grass, to recover what was lost.† But though the straw of grain alone, unless given in adequate quantities, will hardly maintain, and will never fatten stock, yet the straw of pulse, when well harvested, is certainly valuable for feeding, and will save more expensive articles; and there is reason to believe, that a certain proportion of straw, employed in feeding stock, is useful, as well as economical.

On the subject of feeding in general, Mr Young observes, that the real value of straw to a farmer, when it is consumed in feeding stock,‡ is a point very difficult to ascertain, depending on a variety of circumstances, and

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† See the Dumfries-shire Report, p. 349.

‡ In Berwickshire, it is not uncommon to take in cattle for straw, and a few turnips, in which case there is seldom more asked than the value of the turnips, and attendance. Since early kinds of oats were so universally sown, and threshing-machines so generally introduced, the value of straw, as fodder, is much diminished. When crops are clean and luxuriant, and not, as formerly, mixed with grass, the straw, without some

more especially on the price of hay saved, and the value of those crops which farm-yard dung produces. A question, on the whole, more difficult to answer, could not well be put. The subject, however, will be better understood, by considering, 1. The specific properties of the different kinds of straw, employed in feeding stock; and, 2. The rules that ought to be observed when stock are fed with that material.

*Properties of the different Kinds of Straw for feeding Stock.*

1. *Wheat-straw.*—This kind of straw, from its strength, is considered to be peculiarly calculated both for litter and thatching; and indeed, wherever the practice of cutting straw into chaff, for mixing with corn for horses, prevails, wheat-straw is preferred. When given to cattle or horses, it is sometimes cut into chaff in Scotland, and either given raw in that state, or, what is greatly preferred, steamed with other food, in particular with potatoes. Mr Curwen is of opinion, that a moderate quantity of straw, thus given to cattle, contributes much to the health, both of feeding and working cattle. Straw induces them to eat turnips, by cleaning their teeth, and keeps their bowels in proper order.

In order to improve wheat-straw as fodder, it is said to be a practice, in some parts of England, to cut the grain rather greener than in Scotland, which preserves more of the natural juices, and consequently makes the fodder better. Mr Young informs me, that some of the best farmers

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addition of hay or green food, will scarcely keep cattle alive. In Berwickshire, the expence of wintering with straw, and some turnips, is about 30 shillings.

he ever knew, were accustomed to cut wheat much earlier than common in their respective districts. One of these was a miller in Norfolk, who occupied a large farm, where he always cut his wheat several days before any one else thought of beginning, well knowing the good consequences in the value of the grain. It must also be less apt to be injured by shaking or harvesting.\*

It is also not unusual to cut the grain knee high, and only to give, what some consider to be the slender and more succulent parts of the stalk to the cattle, whilst others maintain, that the straw nearest the root is the most nourishing. On this subject, Mr Young remarks, that in regard to cutting grain higher or lower, there are advantages in the former, particularly in threshing, and in more expeditiously carting and stacking; but that the stubble should be cut very soon after harvest, otherwise its virtue, as litter, will be injured; and that it will not answer for thatching, (as practised in some parts of England), or for covering stacks. This high-cutting plan, however, is reprobated in Scotland, on the ground, that much grain is thus wholly lost in cutting, (for a stubble of 12 or 18

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\* Without any regard to the value of the straw, it is allowed to be an advantage, to cut wheat, as well as all other grain, while there is yet much of the natural juices in the straw. Mr John Shirreff is of opinion, that all sorts of grain ought to be cut, whenever the straw, immediately below the ear, is so dry, that on twisting it no juice can be expressed, however green the straw may be in the lower part of the stalk; for then the grain cannot improve, as the circulation of the juices to the ear has stopped. Every hour grain stands uncut after passing this stage, it sustains deterioration, from losing much of its fragrance and peculiar flavour; also its brightness of colour, by exposure to the atmosphere; to say nothing of the risk from shaking by high winds, or even in the act of reaping, if allowed to stand too long. It may require perhaps a common pocket magnifier to ascertain the expressing of the juices, unless where a person has uncommon good eyes.

inches can never be a clean one), and that the expence of the sickle, and of the scythe, are both incurred; nor is the object accomplished, for the cattle will pick and cull the best parts of the straw, without expence, if allowed plenty of it.\* The plan probably originated, from a wish to save barn room; but corn is kept to much more advantage, in stacks.

2. *Oat-straw*.—Among the culmiferous grains, the straw of the oat is considered to be the best fodder, when given uncut. It is well known indeed, that oat-straw, during the winter season, is almost universally given instead of hay, in all the best cultivated counties of Scotland, during the winter months, though that of peas and beans is certainly preferred where both are grown. The straw of the naked oat, (provincially called pilez, or pillas), which is cultivated in the western parts of Cornwall, is much finer than any other sort, and is reckoned almost as good as hay;† and it is said, that the straw of the black, or small oat, with a beard like the wild-oat, is not much inferior.

It has been observed, that a scanty crop of oats sometimes yields good straw for feeding stock. The straw is often mixed with grass, and indeed must resemble more that substance, than when the crop is richer, with a stronger stem. It is by some farmers, reckoned nearly equal to hay, as provender both for cows and horses. But it is a miserable sign of the husbandry of any district, where such an observation is generally applicable.

In some districts, they cut *oats in the straw*, into a species of fodder, which they call “cut-meat.” This is given,

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\* Communication from Mr Dudgeon of Prora.

† Cornwall Report, p. 66.

not only to horses, but to cattle, especially fattening cattle. It is thought to give not only fatness, but a fineness of skin, to all sorts of stock.\*

Since the increased price of hay and corn, *oats in the straw*, cut in this manner, has been given, even to hard-working horses, in stage-coaches, who thus fed, require but very little, if any hay. (See Appendix, No. XXIII.) This is a practice, however, not to be recommended, and has been justly reprobated as slovenly and wasteful. As the proportion between straw and corn is so different, it is quite impossible that a farmer can do justice to his cattle and horses by this practice. Let the corn, it is said, be first separated from the straw, and then mixed *in just proportions*, and the same machinery will both thresh the corn, and cut the straw, as is already done in several parts of Scotland.

3. *Barley-straw*.—This description of straw is, in many districts, condemned, as bad food for stock. In the drought of spring, it is said to be very poor feeding, giving neither strength to the horse, milk to the cow, nor flesh to the ox; and horses, when fed on it, are more subject to botts, (gripes), than when any other kind of straw is given them.

It is certain, however, that the ancients considered barley-straw, to be better for feeding stock, than even wheat-straw.† This probably was owing to the circumstance, that in the superior climate of Italy, barley was better harvested, for it is well known, that of all grain, it is the

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\* Marshall's Midland Counties, vol. i. p. 227.

† See Dickson's Husbandry of the Ancients, (on the authority of Columella and Pliny), vol. ii, p. 408, and 409.

most difficult to secure; and it must be of still inferior quality, where it is cut with the scythe, and spread upon the ground, instead of being put in sheaves, as the air materially injures every species of fodder. Much, however, depends upon custom, for a correspondent informs me, that he feeds his horses, in preference, on barley-straw, and that when he runs short of barley or wheat-straw, his horses do not eat the oat-straw, for a night or two, with appetite. He is convinced, indeed, that the preference given to oat-straw, is not from its intrinsic value, but from the practice of our forefathers in doing so; and very properly, in those times, as the oat crop was always raised in the worst cleaved land, and full of couch, and other natural grasses, which made the fodder better. Barley-straw is said to be still in good esteem in Gloucestershire.†

Mr Thomson, an intelligent farmer, near Edinburgh, greatly prefers barley-straw. He says, that when well harvested, it is much relished by stock, not being tough, but of a brittle quality, consequently easily eaten, and so sweet, that cattle are particularly fond of it. Some horses are subject to colics when fed on barley-straw, which Mr Thomson entirely attributes, to their getting too much water after feeding on the straw. Cows or oxen are never affected by it.

Barley is extremely difficult to save in any tolerable degree of order; the straw, when the crop is fully ripe, is extremely brittle, hence the ears are exceedingly apt to break off in handling, but the straw is more easily eaten. That brittleness, however, it is contended, is a sufficient proof, that it contains little nutritive juices; for what would any one think of brittle hay?

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† Marshall's Rural Economy of Gloucestershire, vol. i. p. 104.

In Middlesex, barley-straw is principally used in packing, and by gardeners.

3. *Bean-straw*.—If well harvested, this straw forms a very hearty and nutritious kind of food for cattle in the winter season. Both oxen and horses, when duly supplied with oats, in proportion to the work they have to execute, thrive well on it; and the reduced parts, or what is termed in England, the coving-chaff, is found valuable as a manger food, for the labouring teams; when blended with other substances, it is probable, that in particular cases, the stems might be cut into chaff with advantage: but when made use of in these methods, it should be used as fresh as possible after being threshed. A mixture of bean-straw, (which by itself is rather dry), and of peas-halm, which is sweet and nourishing, makes excellent fodder.

But though this straw, more especially when mixed with peas-halm, is of great value, as fodder to the working stock of the farm, it does not suit well with riding-horses, as it is apt to hurt their wind. In some horses, both bean-straw, and peas-halm, are apt to occasion colic pains, or the disease which is provincially called *botts*, probably occasioned by flatulency. For this disease, about half an ounce, or the fill of a table-spoon, of laudanum, is found to be a good remedy.\*

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\* This remedy for the colic in horses, has been used in East Lothian for above thirty years. Mr Dudgeon of Prora recommends, if the horse is not deemed in an inflammatory state, to mix half an ounce of laudanum, with four ounces of castor oil, and one ounce of sweet spirit of nitre, with a chopping of water-gruel, which he considers to be an effectual remedy for the colic. Mr Clark of Mayfield states, from his own experience, that in addition to the laudanum, an ounce, or an ounce and

In some parts of Scotland, beans are not cultivated in such large quantities, as to constitute, the whole food, of farm stock, for any considerable space of time : Oat or barley-straw is therefore given them, as their allowance of provender during the night ; and, in the intervals of working, they are fed with bean-straw, as more nourishing.\*

It is singular that in Middlesex, where beans are in general well harvested, the value of the straw should be so little known, as to be generally employed in bedding the farmers' horses, and other cattle when housed, or in littering the farm-yards, when it is picked over by young stock.†

5. *Peas-straw*.—In Scotland, the halm of peas, is used as fodder for work-horses, instead of hay ; and, when well harvested, forms a very excellent provender, insomuch, that it is considered to be of almost equal value as the grain itself. As the halm is seldom sold, there is a want of data on which its weight, and consequent money value, can be estimated ; but a good crop, in favourable seasons, may perhaps weigh 150 Scotch hay stones, or a ton and a half ; and may consequently be worth, in cases where the farmer is allowed to sell straw, from L. 3, 15s. to L. 5, 12s., or even L. 7, 10s. *per* statute acre, according

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a half, (equal to three table spoonfulls), of spirits of turpentine, greatly assists in removing the complaint. Should the animal not be relieved by the first dose, it may be repeated in an hour afterwards, with the addition of an emollient clyster, if the animal is costive. This remedy is not proper in the inflammatory colic, which horses are sometimes subject to ; but that complaint, most fortunately, does not often occur.

\* Moray Report, p. 194.

† Middlesex Report, p. 193.

as the price of hay may happen to be, whether 6d., 9d., or 1s. *per* stone tron, of  $2\frac{1}{2}$  avoirdupois pounds each.\*

Mr Young observes, that the most valuable return made by straw, is that of early white peas, applied to sheep, which, if well harvested, is equal to good hay. Indeed, some farmers are of opinion, that peas-straw, given to sheep, when well harvested, is superior to hay; and on some farms, where sheep make a part of the stock, peas are sown wholly on their account. When there is not enough of straw, or where the corn is of small consideration, the unthreshed crop is given to the flock.† Dr Wilkinson states, that peas-halm, when cut green, and dried suddenly, while in the full vigour of its sap, is fodder of a superior quality, and that horses are found to thrive on it, nearly as well as on hay.‡ When not well harvested, it ought to be used in moderation.

6. *Tare-straw or Hay*.—This is an article by some farmers strongly recommended; for when the land has been dunged, and the seed good, the produce is considerable. The crop should be cut as soon as the blossoms

\* Communication from Robert Kerr, Esq.

† When well harvested, and well kept, the straw of peas is found a very nourishing food for farm-horses; but if spoiled by bad weather in harvest-time, it occasions gripes, and other complaints in their bowels, which have not unfrequently resisted all the veterinary skill of the district. Moray Report, p. 188. A remedy, however, namely, half an ounce of laudanum, has been already pointed out.

‡ Middlesex Report, p. 196. Note. In the southern parts of England, where the tares are in general well harvested, tare-hay is much valued; but in Scotland, where the climate is not so favourable, though horses are fond of green tares, I am informed they will hardly taste the straw or hay, unless compelled by necessity.

begin to fall off, or the pods to form, and the whole converted into hay. Tares require a great deal of sun to cure, and rain is very injurious to them. It would be a good plan, to mix them with dry straw, which would improve both. Three tons of tare-hay, which it is said has been produced in Middlesex, are worth from 12 to 15 guineas. In more distant places, where meadow-hay sells from L.2, 10s. to L.3 *per* load, the tares will be worth from L.7, 10s. to L.9 *per* statute acre.

*Rules regarding the Consumption of Straw in feeding.*

The rules to be observed regarding the consumption of straw in feeding stock, relate to, 1. Cattle; 2. Horses; 3. Sheep; and, 4. To various particulars of a miscellaneous nature.

1. *Cattle*.—Straw is much used in the feeding of cattle in Scotland, and there can be no doubt, that oxen will feed well on straw and turnips, if the straw be good. It is recommended, in all cases, that for a month or six weeks after a bullock is put to turnips, straw only should be given with them: But in the more advanced stages of fattening, hay is so much superior, that it should if possible be supplied. It is certain, at the same time, that hay is a very expensive food for stock, and ought to be saved as much as possible where it can prudently be saved. It is well known that a full allowance of turnips and straw, during the winter months, will fatten better, than a small allowance of hay in place of the straw. In the spring, hay, which retains its nutritive juices longer than straw, is much more valuable, both for fattening stock and feeding horses; and it is therefore the practice in Scotland, to reserve hay

for about three months consumption of these kinds of stock, and for no others.

The superiority of this mode of feeding, with a view to economy, will appear from the following observations. An ox that will fatten on a daily allowance of 20 stones of turnips, with a small quantity of wheat, or of oat-straw, would require three English stones of hay daily, if fed on hay alone. As an acre of turnips, (30 ton), is, to an acre of hay, ( $1\frac{1}{2}$  ton), as 20 to 1; hence an acre of turnips with straw, will go as far as three acres of hay, whilst the ox, at the same time, will fatten much better, and make three times as much dung.\* Straw, therefore, is of great importance in feeding stock, at least in the first stages of fattening, though merely given as a sort of alterative: For it saves hay, which is so expensive a crop to the farmer. Mr Young, on the other hand, recommends this experiment. Weigh two oxen alive; put one to straw, and the other to hay, and after four or five months weigh them again, and the comparative value of the food, in regard to its nourishing properties, will then be ascertained.† It would be proper, at the same time, to have a third ox weighed,

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\* Mr Baillie of Chillingham states, that in several parts of Northumberland, young cattle get nothing but straw, in a fold-yard, all the winter, and are kept in good condition; but they have always much more given to them than they can eat, and of course pick out what they like best.

† There is no doubt that the result of this experiment would be much in favour of hay, for it is admitted that cattle can scarcely subsist on straw alone. It is not urged as a proper food by itself, but it is recommended to give it along with turnips, instead of hay and turnips. Make a comparison between two oxen, the one fed on hay and turnips through the whole winter and spring, and the other fed on straw and turnip through winter, and hay and turnip late in spring, and the result, so far as regards economy, will, it is believed, be in favour of the latter practice.

and fed on straw and turnips, and a fourth on hay and turnips.

When the grain distillery was permitted in Scotland, great numbers of cattle were fed on the refuse; and, twice a-day, straw was given them, along with the grains and wash. It was found, that without straw, they would not feed so well,\* not being so well enabled to chew the cud. The London distillers, however, found straw so dear, that, in general, they preferred hay. The advantage of giving straw, when cattle are fed either on turnips, or the refuse of the distillery, is not so much to be attributed to the nutritive qualities of the straw itself, as that it encourages the animal to eat more of the richer sorts of food, than he would otherwise be inclined to consume.†

2. *Horses.*—In regard to horses, even in the more improved districts of Scotland, they seldom get any hay for three months in winter; but with straw, and the corn, which must always be given them, whether they get straw or hay, they not only plough three-fourths of an English acre *per* day, or work from seven to eight hours at other work, but are actually full of flesh, and vigour, when sowing commences. They must, however, have hay, instead of straw, when the severe labour of spring takes place. When farmers horses are so much reduced in condition, as to be unable to go through the severe labour of spring, it is owing to their not having got a sufficient quantity of corn.‡ Peas and bean-straw certainly make the best fod-

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\* Communication from John Bald, Esq. Carse-bridge distillery.

† Communication from Mr Dudgeon of Prora.

‡ In Berwickshire, straw is very commonly given to horses in the winter months; but there is generally an allowance of Swedish turnips,

der for horses, when not injured by rain; but if that kind of straw is damaged in harvest, white straw is to be preferred.

It is proper here to remark, that where hay can be had in abundance, some respectable agriculturists in Scotland, prefer the use of it to straw for feeding horses. Baron Hepburn says, that it is his practice at all times, when his hay crop is so abundant as to serve both his domestic stables, and his husbandry horses, to give the latter hay during the whole season that they are kept in the stables. Another intelligent correspondent, (Mr Maitland Gibson of Clifton Hall, in Mid-Lothian), has transmitted to me the following calculation of the difference between feeding horses with hay and straw.

One stone of hay <i>per</i> day,           -       -	L.0 1 0
Two feeds of corn <i>per</i> day, averaged at 6d. each, though at this time higher,       -	0 1 0
	L.0 2 0
Where horses are well worked, an additional feed will be necessary; hence	0 0 6
	L.0 2 6

He considers two feeds of corn *per* day, with a proper allowance of hay, to be much better keep for horses, than four feeds with straw; and charging the straw at only 6d.,

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or steamed potatoes, besides three feeds of corn. In East-Lothian, it is a rule to work only five hours, or one journey *per* day, during the winter months. Sometimes two journeys may be taken, but then the horses are better fed.

it makes the expence of feeding with straw the same; whilst at the same time, by the use of hay, his horses are fed in a superior style, two feeds of corn are saved for the market, a greater quantity of dung is made from the straw saved, and the troublesome carriage of hay is in many cases avoided. He hopes therefore, that so advantageous a mode of feeding work horses, will soon become general in this country. On the other hand it is contended, that with three feeds of even inferior oats, and good oat-straw, horses are fully able for their winter work.

3. *Sheep.*—There is no food of which sheep are fonder than peas-straw. The soil of the pastoral districts in Scotland, being rarely of a kind calculated for peas, any extensive cultivation of that grain is impracticable; but where circumstances are favourable to that crop, peas ought to be cultivated, were it merely for the straw, as it would enable the store-farmers to carry on their system of sheep-farming with much more advantage. Indeed the same plan might be advisable in other districts. It may be proper to add, that for ewes at yeaning time, lentil-hay is better than tare-hay, or even peas-halm.

4. *Miscellaneous Rules and Observations.*—On turnip farms in Scotland, it is the usual practice, to feed horses till March, where the labour is not severe, and cows through the winter, with oat-straw, whilst the fattening, and straw-yard cattle, get the straw of wheat and barley. If any peas or beans be cultivated on the farm, that straw being given to the horses, a part of the oat-straw may be left for the fattening and straw-yard cattle. Upon turnip farms, it is not thought profitable to cut the greater part of the clovers for hay. These are usually eaten by sheep, and no more hay saved, than what may serve the horses, cows, and fat-

tening stock, for eight or ten weeks immediately before grass, with a small quantity occasionally given to the sheep fed on turnips. The expence of feeding even the horses alone, for eight months, *on hay*, would be more than a farmer can well afford; at the same time, it is a rule with the best farmers in East-Lothian, to give hay to their horses in the early part of winter, that is, from the middle of October, to the 11th of November old style; then peas or bean-straw, till seed-time commences in the spring, and afterwards hay.

Straw keeps much better unthreshed, in a large stack, than in a barn. Straw in general, more especially white straw, is found to lose its value as fodder, in whatever way it may be kept, after the sharp dry breezes of the spring months have set in.

It is a general rule, that straw, when intended to be used as food for stock, should be given, as speedily as possible, after it is threshed. The threshing separates and exposes it so much, that if kept long, it is, comparatively speaking, of little value as fodder. Lisle, an intelligent writer on agriculture, and a practical farmer, states, that he found cows did not eat straw so well on a Monday morning, as they did the rest of the week, because the straw was not fresh from the flail. Straw, therefore, should be constantly made use of, as soon after it is threshed as possible, for by keeping, it becomes either musty, or too dry, and cattle do not eat it, nor thrive on it so well. It cannot be doubted, that air has a very injurious effect upon all kinds of fodder, and the more it can be kept from the influence of the sun and the atmosphere, so much the better.\*

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\* The reason why hay is less injured than straw by keeping, is its being more closely packed, and consequently less exposed to the influence of the atmosphere.

Mr Young states, that the best mode of keeping straw is, cutting it into chaff, and throwing upon it a moderate quantity of water. If straw must be kept for any length of time, to be used as fodder, it should be bound *in trusses*, in which state it is easier moved, lies in less room, and retains its strength and flavour longer than when loose. Straw in corn, keeps much better in stacks than in barns. It is difficult to say, how long straw will retain its nutritive qualities; but it is said, much longer in a stack with corn, than either in a barn, or in a barn-yard put up in a straw stack.† It is seldom given as fodder, unless to straw-yard cattle, after the month of March.

There is certainly much nourishment in the heads of grain in general, and, in particular, in the awns of barley, for which the cow-feeders near Edinburgh, give a higher price than for the heads of wheat. Barley-chaff is useful to cows, especially if mashed, which is reckoned preferable to steaming, from the greater ease with which it is performed.

When clover is sown with grain crops, the clover has

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† This however is disputed. It is stated in the account of Mid-Lothian, Appendix, p. 57, that if straw is built in ricks, (sows), like hay, in barn-yards, it will retain its nutritive juices better, and be more to the taste of the cattle, than if it had been completely dried before it was led in. Mr Johnstone of Hill-house, (I am informed), threshed some part of his crop directly from the field, in the month of September, and then put the straw in ricks or sows; and in the month of April that straw was better fodder, than what he threshed in April. If this were uniformly the case, it might be advisable to thresh some part of the crop from the field, and to stack the straw. It is evident, that if straw is threshed as it comes from the field in September, and immediately stacked, it will certainly be as good in April, as straw threshed at that time. The reason seems to be, that, in the first case, the straw has more of its nutritive juices when stacked by itself. In the latter, it must stand out longer before it can be stacked with the corn on it.

often arrived at such a length, as to mix with the straw in cutting the crop. This certainly improves the straw in good harvests; but as little clover as possible should be cut with the straw, as it makes it very difficult to secure the crop, unless it be left upon the ground for several days, in what is called, "*The broad-band state.*"

It is recommended, as a useful practice, to mix a proportion of old dry straw, with after-math, or the second crop of clover, or grass. The straw absorbs the natural juices of the green herbage, and thereby becomes fresh and palatable to cattle, the green herbage, being rendered dry by the straw, will not easily heat, and the mixture is not only an excellent food for cattle, but it affords a security against the calamity of want of fodder, by the partial failure of a crop.\* Baron Hepburn approves much of the mixing up any portion of the second cutting of clover that may be left, with old oat-straw. This mode certainly creates some extra expence, for the straw is first carried out to the field, and then brought back in the mixture; but this is the only way of doing the work effectually, and the expence is amply repaid. Dr Skene Keith observes, that care must be taken, to mix the after-math with old straw only, and in a very dry season, as the mixture is apt to rot, if exposed to rain before it is put up in ricks, or in large coles. From the risk attending it, the plan is not so much followed as formerly, though in favourable seasons, more especially where straw abounds, it is certainly to be recommended.

In the consumption of straw as fodder, the inferior sorts should first be made use of, and afterwards those of a better kind. Where straw is used in feeding, the stock should

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\* Aiton's Survey of Ayrshire, p. 269.

have an abundant supply of water, and, if possible, a perpetual fountain at their command. The difference this occasions in regard to thriving, has been found of the greatest importance.

Some farmers give the best straw to the young stock, and the inferior sort to oxen. Others, however, reverse this practice; and it is certain that the best straw, without the addition of turnips, is but miserable food for oxen.

It is disputed whether straw, where it is the chief food for cattle, should be given sparingly, or in abundance. By the advocates for the sparing system, it is maintained, that cattle may be satiated with straw, if served with it in too great plenty, and that they do better, when straw is regularly dealt out to them, than in a plentiful year, when it is thrown before them in profusion. On the other hand, it is contended, that straw is not rich enough to produce satiety;\* hence, that though when it is given to cattle tied up, it may be a good plan to give little at a time; yet that straw-yard cattle must be otherwise treated; nor have any unfavourable consequences ensued, when straw is given in great profusion to young cattle, in fold-yards. By having abundance, they pick out the best, and leave what they do not like for litter.† All that is necessary is, to give them frequent supplies of fresh straw, and to proportion the number of cattle in the yard, to the quantity of straw to be used, so that the dung may be of the best quality. More straw should be given when the weather is wet, and less when dry.‡

The value of straw for feeding, must depend upon the soil and climate. In regard to soil, straw from fertile land

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\* Remark by Mr Anderson of Whiteburgh.

† Remark by Mr Bailey of Chillingham.

‡ Hints from Mr Anderson of Whiteburgh.

is much more nutritive, than from land of inferior quality; as to climate, it is asserted, that the straw of wheat, barley, and oats, contains more saccharine matter, in the southern, than in the northern provinces of France; and that the superior sweetness of the one, over the other, may be ascertained by masticating it.\* In good seasons, therefore, it must be better in this country, than when they are unfavourable.

The straw of some varieties of wheat, have a pith resembling rushes. It has not yet been ascertained whether the straw of those kinds of wheat, be in any respect more valuable, than the common sorts: But there is no doubt that the straw of autumnal-sown wheat, is more harsh, and less agreeable to cattle, than the straw of wheat sown in the spring.†

It is remarked, that the straw of corn, is weaker in countries where the vegetation is rapid, as in Scotland; than in the southern counties of England, where the growth is slower and more regular; and that the straw of crops of barley, sown in the month of March, or beginning of April, grows shorter between the joints, and is much stiffer, than the straw of those crops, sown in the latter end of April, or beginning of May; which latter crops, in wet seasons, generally *fall down*, when the former stand.

The ancients used to prepare their straw for feeding stock in a particular manner. It was cut down earlier, or in a greener state, than other straw; it lay for a considerable time sprinkled with brine, it was then dried, rolled up in bundles, and given to the oxen instead of hay.‡ The

\* Cours Complet D' Agriculture, par Rozier, Voce *Paille*.

† Middlesex Report, p. 220.

‡ Dickson's Husbandry of the Ancients, vol. ii. p. 409.

addition of brine or salt was certainly a good plan, and by a similar practice, the straw consumed in this country, might be greatly improved.

On the whole, any attempt to feed cattle *on the straw of grain alone*, is not to be recommended. There is too much truth in the remarks, “that with no other food, “working animals are thereby rendered unfit to labour, “dairy cows give but little milk, fattening stock get “lean, and young cattle sometimes die of poverty; and “though the farmer, at the end of winter, may have a “large dunghill, the heap is of so poor a quality, that it “will go but a little way in manuring his fields;” yet the case is very different, when a moderate use of straw, mixed with turnips, or any other succulent food, is proposed; or when the straw of pulse, with an adequate proportion of corn, is given to working horses.\* The price of hay indeed, has now become so enormous, that it must enforce, to a certain degree, the consumption of straw; † and that substance may answer, with cattle, in the same manner as certain less nourishing articles of food would do to the human species. It may be of use, in order to fill the stomach and bowels, without which digestion is but imperfectly accomplished. ‡ It is likewise an important circumstance, that feeding cattle and horses partly with straw, in the winter season, is highly favourable to the soiling system; for, though it consumes more straw in

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\* It is contended, that soft food is only calculated for slow-worked horses. Carrots certainly give the most work, and best condition. Swedish turnips the next, and, in moderation, they certainly promote the health of horses, and save other articles. Potatoes, if not boiled or steamed, should be sprinkled with salt.

† Of late years hay has been so very dear, that it is rarely given to black cattle without a mixture of other food, at least in Scotland.

‡ Code of Health, vol. i. p. 333.

feeding stock in winter, yet it furnishes a great deal of clover for summer-soiling, which otherwise must have been made into hay, and consumed in winter, instead of the straw.

It is proper to add, that a variety of food is not only desirable, but useful, and that without some article of inferior quality, rich food, in too great quantities, would become loathsome. Dry food is advantageous, for absorbing the fluids in the stomach, by which that organ has greater power to act upon them, and such food, may not be so necessary, for the sake of the nourishment it affords, as for enabling the animal to take greater quantities of more nourishing aliment.\* Indeed, unless the alimentary canal be properly distended, the richest food will not nourish an animal for any length of time: A dog has been fed on the richest broth, yet could not be kept alive, while another, which had only the meat boiled to a chip, and plain water, throve well.

## 2. Litter.

An intelligent writer on agriculture (Marshall) remarks, that if a Yorkshire and a Norfolk farmer, got equal quantities of straw, the Yorkshire-man would make his cattle eat almost every particle, and would scarcely leave any to litter their stalls with; whilst the Norfolk-man would convert the whole into muck. The Yorkshire-man would keep more cattle, and would carry out his dung at less expence, whilst the Norfolk-man would make more muck.†

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\* Code of Health, vol. i. p. 352.

† Rural Economy of Norfolk, vol. ii. p. 132. A correspondent, who is well acquainted with both districts, observes, that the difference may thus be accounted for:—Yorkshire is a grazing district, corn husbandry

Others would prefer a middle course, that of eating one half, and converting the rest into short or long dung.\*

Straw, when mixed with the dung and the urine of cattle, horses, &c. &c. is a rich and excellent manure; but even alone, when ploughed in, or decomposed by pure simple water, it is of use. All the various sorts of straw answer the purposes of litter. Some farmers contend, that rye-straw is the best litter; others prefer the straw of wheat, which absorbs, it is said, so much urine and moisture, that a cart of wheat-straw is supposed equal in value, to three carts of well-made dung. In England, the straw of peas and beans is extremely valuable, forming, it is said, when well broken by threshing, a desirable litter for working horses, hogs, and other stock; but in Scotland, it is never used as litter, unless it has been spoilt by bad management, or a most unfavourable season in harvest, as its feeding properties are there so well known. Littering, it is said, is of use, not only for converting straw into manure, but for keeping the animals warm and dry. In fact, cattle cannot be soiled on clover, or fed on turnips, without abundance of litter.

There are four modes of converting straw into dung, by littering stock. 1. In stalls or stables; 2. In hammels;

therefore, comparatively speaking, meets with small attention; whilst, in Norfolk, arable husbandry is extensively followed, and of course straw is a most abundant article.

\* Short dung does not depend upon the length of the straw from which it is made. Short muck, is farm-yard dung, that has undergone putrefaction, to which fermentation is necessary, whether the straw is long or short. Perhaps straw cut short, might accelerate fermentation, by absorbing a greater portion of moisture, and a practice of this nature, might be useful, by accelerating fermentation, when, from want of turnips, it is found difficult to convert straw into manure.

3. In fold-yards; and, 4. In open folds, where sheep are littered with straw.

1. Lord Kames strongly recommends feeding cattle in well-littered stalls, as a better mode of making dung, and more beneficial to the animals themselves, than in a dung-yard, even though there may be an open shed to retire to, in bad weather. The nearer the air approaches to the heat of blood, the better, he contends, will the cattle thrive; a cow, when comfortably sheltered, gives more milk,—and an ox intended for the butcher, fattens sooner than when exposed to the vicissitudes of the seasons in a dung-yard.\* The greater proportion of practical farmers in the Lothians, concur in these opinions. It is remarked, at the same time, that other kinds of stock, besides cows giving milk, and oxen intended for the butcher, may be employed in converting straw into dung.

Mr Bailey of Chillingham, on the other hand, contends, that though tying up cattle in stalls is the most likely means of making cattle *eat the whole of the straw*, yet they will certainly thrive much better, and will make a greater quantity of manure, owing to more straw being required for litter in the one way than in the other, in a fold-yard with sheds, than in stalls. They will also eat out of doors, what they refuse in the house. Mr Clark of Mayfield is of the same opinion; but says it requires sufficient accommodation, to prevent the cattle from running and pushing at one another. He therefore recommends a cross wall, six or seven feet high, in the middle of the feeding yards, as the simplest and best mode of preventing such mischief. Every plan, however, has its advantages and defects. It is certain that lean straw-fed cattle

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\* Kames' Gentleman Farmer, p 204. Before this work was published, Mr Young, in his Eastern Tour, recommended this practice, on the authority of Mr Moodie of Retford.

require more shelter, and even closer houses, than cattle kept on richer food. But there is a medium to be observed in this, as well as in other things. The hair of cattle, kept in a close warm house, naturally grows thin and peels off prematurely, which would expose them to much unnecessary hardship, if they were to be turned out to grass in spring.\* Whereas, as Baron Hepburn well observes, a bullock, with plenty of good food, despises cold; hence, where the object is to fatten to perfection, he should be enabled to live as nearly as possible in the style in which he would live, if he had artificial food at command, and were left at perfect liberty. That is to say, his great object would be, to eat in the open air, and to lie dry. In this way, with abundance of fat, he joins a *firmness of carcase*, which no stall-fed bullock ever possesses, whose fat, in the pot, melts into oil, and whose flesh, from the spit, comes lean, dry, and tasteless to the table.

Marshall assigns another reason for preferring stalls to the fold-yard, namely, that the straw being given in small quantities, is eaten with an appetite, whereas in a farm-yard, they go loose, and have it in too much abundance.† Another reason is, that in all the grazing districts, straw is so scarce an article, that it is necessary to use it in the most economical way.

2. An ample description of *hammels*, or cattle-sheds, has been already given. (See p. 25.) The only objection to this mode of feeding cattle is the expence; but even that objection, in regard to horses, is compensated, by the superior healthiness which results from that system.

3. Lord Kames strongly objects to fold-yards for feed-

\* Marshall's Rural Economy of Yorkshire, vol. i. p. 403.

† Marshall's Gloucestershire, vol. ii. p. 50.

ing cattle, as such an inclosure is subject to whirling winds, which pinch them, even in fresh weather, and never will preserve them, in a kindly heat, in frosty or unfavourable seasons. But the principal objection he makes to the fold-yard system is, that half-rotten dung, trodden under foot, and kneaded together by the cattle, excludes the air totally from the inner parts of the heap ; and it is a truth which, he contends, is indisputable, that putrefaction does not go on without air, as well as without moisture.\* This evil might certainly be easily remedied, by frequently removing the dung. Mr Young, however, contends successfully, that preventing fermentation, with dung raised during the months of December, January, and February, (a period during which it cannot with propriety be used), is no objection to the practice, in so far as regards the dung ; and it is well known, that the dung may be taken out from the fold-yard, and put into dung heaps, where it is fermented in proper time, to be made use of. Straw-yards ought to have a southern exposure, and be placed in a sheltered situation, with a constant supply of water where possible. Cattle wintered in the straw-yard, are much preferred to those wintered in the house, either for driving or grazing at home.

4. In regard to open folds, where sheep are kept littered with straw, thrown in from time to time, (a description of which will be found in Appendix, No. XII.), the straw is not only mixed with the dung of the sheep, but absorbs all their urine, and by that means, one acre of straw alone, will produce six large cart-loads of dung, of a very superior quality.

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\* Mr John Shirreff is of opinion, that it is an advantage to prevent too rapid fermentation, and still more so, putrefaction ; and the custom of taking out dung from the yard to the field, to heat and evaporate, he considers to be a destructive system.

This mode of littering, however, has been objected to. It is said, that it exposes too great a quantity of dung to the action of the atmosphere; and that sheep would thrive better, even in a wet turnip field, than when turnips are laid down to them upon a clean grass field; for the turnips, when thus laid down, roll about at every touch, in consequence of which the sheep never improve upon them so well, as when the turnips are fixed in the ground. Experience alone can ascertain whether these objections are well founded.\*

The expence of littering horses, and the return in dung, is another point to be ascertained. Littering a pair of coach-horses in Edinburgh, costs about L. 6 *per annum*. In Middlesex, it is calculated that it requires a load of straw, or 1296 lbs., worth, on an average, L. 1, 10s., to litter a farm-horse for the year. The horses generally lie out three months in the year, and the dung of the remaining nine months is said to be worth about L. 2.

In the London markets, straw for litter is drawn straight, in handsome trusses, and straw threshed by mills is less saleable, on account of its being more bruised, and less sightly in the truss. Perhaps when unbruised it may last longer, which is an object where straw is so dear; at the

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\* It is likewise objected to the plan above alluded to, that the turnip field is broken and poached with carts, and does not receive the benefit of treading by sheep, which light turnip soils so much require. This treading not only tends to destroy annual weeds, but also leaves the land in the best possible state for wheat or barley, with grass seeds. There is no supply of dung that will make amends for the want of this treading or consolidation. As to the making of dung, the same quantity may be made by cattle in straw-yards, with a third or fourth part of the turnips drawn from them. The sheep being afterwards folded on the remaining turnips, as well as on the ground from which the turnips have been drawn, the whole land is equally manured and consolidated.

same time it is probable, that the advantage of a softer bed for the horses, would more than compensate for any additional expence.\* It is singular that the ancients were accustomed to break straw upon stones, for the purpose of rendering it more easily mixed with dung, and sooner dissolved;†—an operation which is now effectually done by means of the threshing-mill.

A farmer in Berwickshire calculates the value of an English acre of straw, for dung, in the following manner. He gives a single cart-load of turnips *per* day to eight or ten cattle, with straw, in a fold-yard. He finds, that on an average of three years, from two and a half, to three acres of straw, will winter an ox, with turnips in the above proportion. In this way each acre of straw will produce about four double cart-loads of rotten dung, of from 30 to 35 cubic feet each, which at 5s. *per* load, is 20s. *per* acre. The dung, however, in this case, seems to be estimated too low.

An important question comes next to be discussed, What quantity of straw employed as litter, and converted into dung, feeding the animals on straw and turnips, will be sufficient to manure an acre for turnips or wheat?

There is reason to believe, if all the straw produced upon a farm were converted into dung, by feeding cattle with turnips in winter, and by soiling in summer, the produce of two acres of corn-straw, and one acre of grass, cut for soiling, and consumed on the farm, would give manure for one.

On this branch of the subject, it is intimated to me by Mr Brown of Markle, that the quantity of dung produced

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\* Middlesex Report, p. 175.

† Dickson's Husbandry of the Ancients, vol. ii. p. 408.

from a given quantity of straw, depends a good deal upon the kind of straw that is used, (as some kinds absorb much more moisture than others), and upon the degree of care employed in preparing the dung. Speaking generally, Mr Brown reckons that the original weight of straw may be tripled, if the manufacturing process be properly conducted, and the dung applied to the ground before its powers are lessened or exhausted. The average weight of straw in well-managed districts, (and it is only to such that the following estimate is applicable), may be calculated at 130 Scotch stones, of 22 lb. avoirdupois each, which is one ton, five and one-half hundred weight *per* acre. He thinks the quantity of dung which may be made from an acre, especially if the dung arising from clover, turnips, and hay consumed on a farm is included in the general stock, will be something more than four tons; consequently that any farm of decent soil, may be manured at the rate of 12 tons *per* acre, every third year, from its own produce, provided the corn crops are cut with accuracy, and the straw be manufactured into dung in a husbandman-like manner.

Mr Hope of Fenton calculates, that from 30 to 35 stones of straw, of 22 lb. each, used as litter, or in the fold-yard, will produce a ton of well-rotten dung; consequently, that 130 stones, the average produce of straw, *per* English acre, will give 4 tons.

If these calculations be right, it would appear that, on a farm where 300 acres are sown yearly, 100 may be manured from its own produce, at the rate of 12 tons *per* English acre, without any extraneous manure, on the four-course system, 1. Turnips; 2. Wheat or Barley; 3. Clover; and, 4. Wheat or oats. They are founded, however, upon the principle of converting nearly the whole white straw into dung, by consuming turnips and clover upon

the farm. If that straw be much used as food for cattle, the quantity of dung manufactured would fall considerably short of what is above stated.\*

Mr Young, who has directed so much attention and ability, for so many years, to agricultural pursuits, is of opinion, that one ton of straw will make four tons of dung; but if earth of any kind, (peat earth in particular), were used for retaining the fluid, the quantity of dung would depend upon the proportion of that material, and may be increased to seven, eight, nine, or ten ton *per* acre, according to circumstances. It is certain, that according to the common management, much urine escapes; and he is inclined to believe, that by careful attention, two tons of straw, when the cattle are fed on rich food, amply littered with straw, and the urine absorbed by good earth, would manure an acre of turnips.

The advantage of using rich dung, in preference to that derived from inferior articles, cannot be too strongly impressed on the mind of the farmer. Mr Young once employed himself in ascertaining, by experiment, on two successive crops of potatoes, estimated at 1 s. *per* bushel, what was paid by increase of product, above the division that had no manure, and the result was as follows :

Bones <i>per</i> cubical yard of the manure, -	L. 2 12 2
Night-soil, - - - - -	2 10 0
Fat hog-dung, - - - - -	0 17 4
Common farm-yard compost, - - -	0 9 8

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\* Where a farm is divided into five breaks, pasturing the clover break for one year, may be done to much advantage, as, after a year's rest, less manure is necessary, and the produce of straw will be more abundant in the remainder of the course.

This surely proves the immense importance, when we carry dung to our fields, that it shall be of superior quality. It is a pity, that the dung of a fat bullock, eating oil-cake, had not been tried at the same time; and still more so, the mere produce in dung, of a lean straw-fed cow or ox, unmixed with that of horses and hogs. In Mr Young's opinion, it would not probably have paid more than 4 s. or 5 s. *per* cubical yard.

On this subject, it may be observed, that the real value of the dung of animals depends partly upon their own nature, but principally upon the food they eat. The dung of pigs and poultry is certainly the richest, and that of pigeons the hottest and quickest. In regard to the larger animals, the dung of horses fed on oats and hay, is richer than that of cows, maintained on inferior food; whilst the dung of a well-fed cow, is better than that of a horse, fed on straw, or poor grass.

We now come to discuss a point of still greater importance.

Mr Young observes, that it is impossible to raise manure in sufficient quantities, (above all where soiling is practised), if straw be eaten. The best farmers in Norfolk, consider it as essential, that all straw should be used as litter, and trodden into dung, by animals feeding *on much better food*;\* and an eminent Norfolk farmer, (Mr Money

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\* Mr Robertson of Ladykirk is of the same opinion. In respect to the management of straw at a distance from towns and villages, he thinks that every particle of it ought to be made into dung, and not eaten by cattle. The better the meat given to live stock of all sorts, the more valuable will be the dung. Lean stock, half starved on straw, make bad manure, and little of it. Mr Brown remarks, that if a full supply of green food be given to cattle, they will eat very little of the straw. If soiled upon grass, they will not taste it.

Hill), remarked to him, that no system could be adopted, more calculated for the impoverishment of a farm, than that of applying the straw, as the food of dairy cows, instead of treading it into dung. Nothing can be more opposite to this, than the system of Mr Middleton, who states, that the more the straw is bruised, the better for the farmer's stock; and probably if the whole were cut into chaff, it might, by a mixture with roots, *be all eaten by cattle*.\*

On the subject of *better food*, Mr Bailey of Chillingham remarks, that probably turnips, or oil-cake, must be meant. In regard to the former, a number of farms produce no turnips; how then is this *better food* to be obtained? and how is the straw to be converted into manure, unless given to young cattle in a fold-yard, without turnips, which the farm does not produce, or oil-cake, which is not to be had, but at too great an expence to make the practice general. And in regard to hay, that is likewise too costly an article.

As the farmers in Norfolk, who are undoubtedly among the most respectable in this, or any other country, do not find even this system of converting all their straw into dung sufficient, but are often at great expence for foreign manures, it is proper to enquire, whether their straw be converted into manure *under a proper plan*.

It is remarked by Mr Curwen,† that under the existing system, the Norfolk farmers maintain their fattening cattle *with dry food*, the expence of which is so heavy, as to preclude many farmers from keeping half the stock necessary for converting their straw properly into muck. Cattle fed on hay and oil-cake, never produce the same quan-

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\* Middlesex Report, p. 171.

† Workington Report, *anno* 1812, p. 78.

tity of urine as when they are fed on turnips, by which dung is rendered so valuable; for without a sufficiency of moisture, straw is never properly decomposed by fermentation. It would probably, therefore, be a great improvement in their system, if, instead of hay and oil-cake, they would feed their cattle with straw and turnips. Their cattle and horses should all be soiled in summer, instead of so large a portion of their clovers being consumed by sheep. By following this plan, they would soon have, if they adopted the system of drilling turnips, manure enough to raise from 30 to 40 tons of turnips *per acre*, instead of their present scanty crops, not exceeding from 15 to 20 tons; *and no foreign manure would be necessary.* The whole depends on soiling cattle and horses in summer, feeding cattle with straw and turnips, and horses with straw and ruta-baga, three months in winter, and converting all the rest of their straw into dung, well saturated with urine. On this point, some additional observations will be found in the annexed paper, which contains a number of important particulars regarding the usual mode of converting straw into dung in Scotland, especially on turnip farms.

On the subject of littering, two questions remain to be discussed; 1. Whether littering with straw could be dispensed with? and, 2. What other material could be employed for absorbing the urine of stock?

1. In Arabia, where the finest horses in the world are kept, no litter is used; and I remember, when on a visit, in the year 1786, to the celebrated Count Alexis Orlov Chesminsky at Moscow, that his horses were not littered, though he paid very particular attention to them. Horses might lie very comfortably, by having the corners of their stalls filled up with boards, on which some coarse

cloth might be fixed by tacks, if considered to be necessary.\* I am convinced, that horses are much the worse for standing on hot litter, which brings down the humours to the feet, and occasions grease, unless when the dung is regularly removed.† A horse also, accustomed to stand on so soft a material as litter, must be more apt to suffer, when he gets on hard roads, than if he stood on boards. Nor is litter necessary for cattle. In a distillery at Battersea, near London, stalls were erected to feed 500 cattle at a time; they both stood and lay on a framing, (a kind of trellis), of wood-work, raised a little above the pavement, and they were not allowed straw, or any substitute for it, as bedding.‡ It is also said that horses lie on boards in some parts of Sweden.§

2. The principal advantage of littering, therefore, arises from the straw absorbing the urine, for which it is a material certainly well calculated. But wherever straw is scarce or dear, for the mere absorption of urine, peat earth, or fine mould, might be advantageously employed, at least in aid of the other; and if horses and cattle were to stand on platforms, with holes in the boards on which they stood,

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\* I am informed, that the late Mr Wedderburn of Birkhill, in Fife, owing to the high price of straw, was induced to try the experiment of keeping his riding-horses on boards, grooved so that the urine might run from under them; and that he found this plan to answer preferable to litter, the horses suffered no inconvenience, but, on the contrary, rather improved in their coat. Others conceive it impossible, that rest can be obtained equally well on boards, as on good straw. Rest, it is said, in the best possible manner, is peculiarly necessary for horses, owing to the severe labour to which they are subjected.

† It is said, What horses have cleaner limbs, or are better littered, than the English hunters and racers? But then they are well curried, and carefully attended to.

‡ Middlesex Report, p. 328.

§ Ditto, p. 364.

and fine earth below, for absorbing the urine, there is reason to believe, that straw would not be necessary for littering cattle, if any other useful mode of applying it were ascertained.

### 3. *Thatching.*

For many ages, straw was the common material, for roofing farm-buildings and cottages; and was formerly made use of even in towns. This mode of roofing has still its apologists. It is said, that the expence of a thatched roof is not great, in so far as respects labour; and the value of the straw is, to the grower, either the price he could obtain for it, or that of the dung that could be made from it, as the kind used for thatch is seldom consumed as fodder. Where economy must be attended to in the building of cottages, straw is taken as the least costly material, but in these days, when manure is so extremely valuable, as little straw as possible should be spared for other purposes.

The durability of a thatched roof is likewise maintained. It is said, that a good coat of thatch, will need very little repair during an ordinary lease. But care must be taken, that the straw is very clean threshed. If it is not, the grain left will soon spring, and introduce putrefaction, and encourage vermin. The threshing-mill, it is supposed, renders straw less fit for thatch, than when it was threshed by the flail.

Thatching, however, is not so common as formerly. The risk of fire, the broken state of the straw when threshed by mills, and the increased demand for manure, in consequence of the improved state of agriculture, have all contributed to this effect. Besides, there is an additional expence of insurance against fire. In common buildings,

it is only 2 s. *per* L. 100, whereas thatched barns and out-houses are called *hazardous*, and charged 3 s.; and all other thatched buildings, and the goods and merchandize therein contained, are called *doubly hazardous*, and charged at 5 s. *per cent*. Thatching is still much used for cottages, being warmer than tiles, and slates are often at a great distance, and very expensive, especially with *sarking*.\* Probably a good slate roof, is in every case the cheapest at last, but it is not so for the farmer, who often builds cottages at his own expence. Some late improvements in regard to tiles, however, may contribute to render them more general, and to make thatching unnecessary.†

In Somersetshire, wheat is seldom threshed with the straw, but the ears are cut off, and the straw, bound in sheaves, and tied very tight, is used for thatching.‡

\* It may just be noticed, that there are many slate roofs, without *sarking* deals. The slates are hung with a pin on laths, and *rendered*, as it is called, with lime, in the same way as tyles. This is the usual practice, even with the best houses, in some of the western counties, and is much less expensive, than the common method of nailing them to *sarking*. This method, however, does not answer so well in high and moist situations.

† A French architect, (M. Costola), recommends tiles of a square, instead of an oblong form, and that the hook that fastens them, shall be at one of the angles, so that when fastened to the laths, they may hang down diagonally, and thus every tile is covered one-fifth part on the two sides, by the superior row. It has also been discovered, that tiles are greatly improved, and rendered impervious to water and frost, by being rubbed over with tar, before they are laid on the roof.

‡ The circumference of the sheaf, at the bond, should be six feet, which costs five-pence *per* sheaf, including the threshing of the ears. A good acre of wheat will produce three dozen sheaves, value 8 s. 6 d. *per* dozen, and each sheaf should weigh fifty-six pounds. This would make only 91 seven-elevenths stones, of 22 lb. each, to the acre, but the heads and part of the straw are cut off. By this method, the firmness of the

Mr Young observes, that thatched buildings lessen the quantity of dung upon a farm, to such an extent, that they ought to be universally prohibited. No material of that sort, in his opinion, is admissible for that purpose, but fen reeds, and in mountainous districts, heath.

#### 4. *Miscellaneous Uses of Straw.*

It is well known, that various articles are manufactured from straw, such as bonnets and other ornaments for the

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stalk is preserved; and it is considered to be more valuable for the purpose of thatching buildings. The provincial term for this management, is called "*ear-pitching*," and the sheaves thus prepared, are called reed-sheaves. A dozen of sheaves will cover a square of 100 feet. The price of laying them up, (if new work), is 3 s. *per* dozen. A second, or any succeeding coat, 2 s. *per* dozen. Mending, 4 d. *per* sheaf. The workmen are very dexterous in making, and the thatchers no less expert in using, the straw thus prepared; and whilst it makes a covering more durable, it is said, than any other of straw, it is of such superior neatness, that the thatched buildings of Somerset, excite the admiration of every stranger, coming from districts where this practice is unknown. It is far from being universally admitted, however, even in Somerset, that the unthreshed straw is more durable than the threshed. On the contrary, some assert from experience, that the hollow tube of the wheat-straw, admits the air, and that its decay is thereby accelerated.—*Somerset Report*, p. 97, 98.

It is remarked, in the Middlesex Report, that it would be desirable to know, besides the particulars above stated, the nature of the process of cutting the ears of wheat from the straw, the expence *per* quarter, the manner of getting the straw out of the ears, &c. It is contended, that unless where the practice of Somerset is adopted, that all straw, intended either for thatching or even for littering stables, should be threshed by the flail, as the threshing-mill bruises and cuts it shorter, and hence that it is sooner soiled.

ladies.\* The quantity thus used is very considerable, and it furnishes employment for numbers of persons, who might otherwise with difficulty find the means of subsistence.

In Essex, and in other parts of England, straw is employed for the purpose of under-draining; and a machine has been invented, to twist the straw into ropes, for putting into the hollow. But wherever the tops of green furze or whins can be obtained, or the small branches of black thorn, or the peelings of willow, or tiles, or stone, straw should never be made use of. In draining with stones, straw is sometimes laid above the stones, before the earth is thrown in, to prevent it from getting down. If old turf is at hand, it is used by some, placing the grassy side undermost. Others contend, that it is better to rob the land of manure, than to annihilate the soil itself.

Straw is also used for covering hay and corn stacks; and where it is the practice to cut the wheat crops at a

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\* Northumberland Report, p. 188. Even in the remote county of Caithness, the straw manufacture is carried on. The straw is prepared in London, and the plait returned to that market. It employs 260 women and girls, who earn, on an average, about 3s. *per week*, or L.2028 *per annum*. This branch of industry, furnishes employment to girls, who are not capable of performing any labour that would require great exertion, and who would otherwise live in idleness, at the expence of their parents. Caithness Report. Addenda, p. 291. On the same system, the manufacture of straw has been established in the Shetland islands. Straw-plaiting is the principal manufacture in Bedfordshire. Children of ten or twelve years of age, can earn at it from 6s. to 7s. *per week*; and some experienced plaiters boast, that they can gain even a guinea a-week in the spring season, when the article is most in demand; but from this sum the expence of the straw, and the time employed in sorting, whitening, &c. which are considerable articles, ought to be deducted.

great height, the stubble is mown afterwards, close to the ground, and collected for that purpose. Thatching with broom, however, if it can easily be had, is by some thought preferable to straw for corn stacks.\* In regard to stacks or ricks of hay, it is the practice of Wensley-dale, in Yorkshire, (see vol. II. p. 58), not to cover them with straw, when the rick is built of a cylindrical shape below, and a conical shape above. In that district, ricks are carried up to so regular a point, and roped so closely and neatly, that they are neither injured by time nor tempest.

In some districts, straw, mixed with clay, is used, for building the walls of houses or gardens;† and with the same mixture, for the roofs of houses, instead of the common mode of thatching.‡

There is a singular mode of using straw, adopted in some parts of Lincolnshire, namely, *burning it for manure*. Straw, there, is of little value, being worth only from 4 s. to 5 s. per ton; and from five to six ton, which is spread dry on the ground, is said to be sufficient for an acre.§ This practice, however, is not to be recommended. In the process, nineteen parts out of twenty will be dissipated in the air in the state of gas, and the small quantity of ashes left, if found to be useful, might be supplied much cheaper, by sowing pot-ash by the hand.||

In districts on the sea-shore, it is common for experienced farmers, to keep in reserve a considerable proportion of their wheat or barley-straw, and to make it into a dung-hill, alternately with the sea-ware, *stratum super stratum*,

\* Scots Farmer, p. 595.

† Statistical Account of the Parish of Dornock.

‡ Report of Sutherland.

§ Agricultural Report of Lincolnshire, p. 267.

|| Remark by Mr Clerk of Mayfield.

till both are exhausted. This speedily forms a compost of the first quality, and prevents a waste that would most infallibly ensue, by the melting and running off of the juices of the sea-ware, which invariably happens without this precaution, to the amount of three-fourths of the whole mass. This is an excellent plan where the sea-weed cannot be *immediately* applied, but it is the best system, to plough it in, when obtained.

Near Gloucester, great quantities of bean-halm, (as well as common straw), are bought up at a pot-ash manufactory, and burnt for the ashes.\*

Among the various other objects to which straw has been applied, it must not be omitted, that attempts have been made to convert it into paper, which, after some expensive experiments, were abandoned.

Straw, to a considerable extent, is used in making collars for horses, or *brahams*, as they are called in East-Lothian.

Straw is also used for stuffing beds. For that purpose the chaff of oats is found to be a material not much inferior to ordinary feathers; and being so much cheaper, chaff beds are almost universally used by the lower orders in Scotland.

Another purpose to which straw is applied, is that of packing; and it is proper to observe, that the quantity used in packing china and stone-ware, in the districts where those manufactures prevail, as in Staffordshire, is found to be a serious injury to the farmer.

The most recent discovery, connected with any straw production, is that of the Rev. James Hall, who has ascertained, that every bean-stalk, according to its size, contains from 20 to 35 filaments, which are of a nature among the

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\* Marshall's Gloucestershire, vol. i. p. 153.

strongest and most durable hitherto discovered. He calculates, that, on an average, there are about 200 lb. weight of such filaments on an acre, capable of being applied to various useful purposes, where durability and strength, rather than fineness and delicacy, are required.

It is suggested by Sir Humphry Davy, in his celebrated Lectures on Agricultural Chemistry, recently published, that though it is usual to carry straw, that can be employed for no other purpose, to the dunghill, to ferment and decompose; yet that it is worth experiment to ascertain, whether it may not be more economically applied, when chopped small by a proper machine,\* and kept dry, till it is ploughed in for the use of a crop. In this case, though it will decompose much more slowly, and produce less effect at first, yet its influence would be much more lasting.†

The advantage to be derived from this suggestion, can only be ascertained by experiment. It is certain, as Mr Young maintains, "That by fermentation, straw is reduced into a gaseous state, or with moisture, into a fluid state, and in either case is absorbed by the roots of plants; and that by fermentation, a dunghill may be turned and mixed, (provided there be no earth in it), until it become a very inconsiderable heap." But how it may operate as manure, without fermentation, is a different question; and if the advantage is remote, farmers will probably prefer immediate, to eventual profit. It would be the most likely to answer with a potatoe crop, in drills; for, as the straw decayed, (if that were the case in one season), the pota-

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\* This might easily be effected by machinery attached to the threshing-mill.

† See Lecture VI. p. 247.

toes would occupy the space. Turnips require moist and rotten dung.\*

On the whole, the subject of straw, is one of much greater importance than is commonly imagined, and its value, taken in the aggregate, is so very great, that it is well entitled to more attention than hitherto has been be-

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\* Upon communicating these observations to Mr Clennell of Harbottle Castle, in Northumberland, he informed me, that he had tried an experiment, on a small scale, in cultivating potatoes with several sorts of manure. 1. Merely dry straw; 2. Straw from the stables, from the head of the stall, bruised by the feet of the horses, but which had not been impregnated with dung or urine; 3. Damaged hay; and, 4. Fine rotten manure from the dunghil. These were placed in separate drills, to ascertain the effects of each. From the three first sorts of manure, an abundant crop of large and mealy potatoes were procured. The potatoes from the sets planted with rotten dung, were only equal in quantity with the others, and by no means so good in quality; in so much, that the difference was at once perceived when dressed for the table. The potatoes were taken up early in the season, as they were wanted. The dry straw, (which had not been cut, but placed lengthways in the drill), remained nearly entire; but perhaps had the potatoes not been taken up till quite ripe, the whole straw might have been consumed, which was the case with the other two sorts of rough or unfermented manure.

Mr Clennell has furnished me with the following hints regarding the culture of potatoes. 1. The potatoes for seed, should be kept in a separate pit, which should never be opened, until the time when the potatoes are to be cut into sets; for if vegetation commences any time before the potatoes are to be planted, it is apt to occasion the curl. 2. The sets should be placed about a foot separate from each other; for when properly cultivated, the crop will be abundant. Mr Clennell has found, at that distance, that each set has produced thirty merchantable potatoes. And, 3. Many crops of potatoes are spoiled from being planted too deep in the ground. This ought to be carefully avoided. He strongly recommends, the white American potatoe, which has been lately introduced into Northumberland, and which is early, keeps well, and is prolific.

stowed upon it. Farmers are too apt to consider it as of little or no value, because it is not generally saleable, and is rarely estimated separately from the yearly produce of the soil. But though it is not in general, (except in the vicinity of towns), a marketable commodity, yet it is a fund, which, under proper modes of consumption, is necessary to preserve our tillage land from deterioration, and on which the amount of its future produce most essentially depends.\*

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\* Remark by Alexander Low, Esq. of Gordon Bank, an eminent Scottish agriculturist, and land-surveyor.

On the subject of converting the whole of the straw into manure, by littering it, Mr Young states, that every doubt upon that subject would be removed, by considering the detail of a farm, where such a plan was practised, founded on certain data, relative to the several objects of rotation, product of straw, demand for litter, and proportioning the fattening beasts kept the year round in the stalls, with the litter thus necessary. Such a plan would demand from twelve to fourteen fat oxen, to every pair of horses employed, and either six acres of lucerne, or twelve of good natural grass. He adds, that the great reason why such farms are not to be found in every district, and that the practice of feeding with straw is defended, all resolves itself into want of capital, for such a system requires a far greater sum than farmers generally possess.



# ADDENDA.

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## No. I.

HINTS REGARDING THE QUESTION, WHETHER ALL THE STRAW OF A FARM SHOULD BE CONVERTED INTO DUNG, OR PARTLY CONSUMED IN FEEDING STOCK.

MR ARTHUR YOUNG, and Mr Money Hill, certainly highly respectable names, contend, that no part of the straw should be eaten, but the whole converted into dung. But cattle in Norfolk, it is said, eat little or no straw, and yet the farmers never have enough of manure; they lose, at the same time, considerably by their cattle, which they feed on hay and oil-cake. Their very inferior crops of turnips, few of which can be spared for the straw-yard, and their neglecting to soil, sufficiently account for their deficiency of manure, and the great expence of oil-cake and hay, for their loss upon cattle. But there is nothing of the latter at least, known in Scotland, and we certainly make as much of our straw into manure as they do. It may be proper, therefore, to detail the practice of Scotland, supposing the farm of a turnip soil, under the Norfolk rotation.

The crops in Scotland, upon a farm of 400 acres, under a four-years course, are, 100 acres of oats or wheat, after clover; 100 acres in turnip and potatoes, upon the preceding division; 100 acres of wheat, barley, or oats, after the turnip; and 100 acres of grass to succeed these crops.—If the soil is so good, as not to require pasturing the clovers, the farmer will cut perhaps 20 or 30

acres for hay; as much or more, according to his quantity of summer-straw for soiling; and pasture the remainder with his own and servants' cows, young cattle, and a few ewes and lambs. As to turnips, it would be out of all reason to carry home to his straw-yard any thing like 100 acres, and besides, it would require so many cattle to consume them, that a fourth part of their urine could not be absorbed by all the straw on the farm. Probably he carries to the straw-yard 20 or 30 acres only, as in the case of soiling, and goes to market for a lot of wethers to eat the remainder on the ground, to be sold fat in the spring.—If he were to soil with all his clovers, besides that he would have no hay at all, he could not have straw sufficient, if any part were used in winter; and if the whole, or nearly the whole turnips, were eaten in the straw-yards, he could have no straw for summer-soiling. But he threshes his crop regularly throughout the year, and reduces the straw to manure, by turnips in the winter months, and by soiling in summer, as he threshes. Again, if he were to cut the whole of his clover for hay, there could be no summer-soiling, and all his hay of 100 acres would do little more than feed the cattle kept with turnips, in such numbers, as would be required for converting all the straw into dung. He would be sometimes even under the necessity of going to market for more hay, for his horses, cows, and other house-stock, as well as to pasture his horses and cattle in summer, upon some old grass, or rented grass-parks, instead of soiling. He would therefore soon find, as in Norfolk, that straw-yard cattle would not pay for this hay, and far less for oil-cake, as has been well observed by Mr Bailey; for in five months each beast would eat a ton of hay, though only allowed 16 lb. a-day, and he would eat this, and more, with a straw-yard allowance of turnips, and a little of the straw within his reach besides. This would add L. 5 to his cost, and if L. 2, 10 s. is allowed for a quarter of an acre of turnip, there is L. 7, 10 s. besides straw for wintering, risk, and interest of money. No straw-yard cattle ever pay nearly so much.

These observations relate to the usual practice, where a few cattle only, or sometimes none at all, are fattened. Feeding for the butcher can only be carried on with advantage to a very li-

mitted extent in Scotland, and it is in general thought more profitable to fatten sheep than cattle on turnip farms. The advantage of eating turnip on the ground by sheep, is fully recognized in Scotland, as well as in Norfolk. But a crop of 30 tons, will allow a fourth part or more to be drawn for the straw-yards, instead of converting the straw into dung, as in Norfolk, by means of hay and oil-cake. With regard to converting the straw into dung, by littering cattle fattened in stalls or hammels, it is only necessary to observe, 1. That they would need twice as many turnips at least, or rather three times, which a clay-land farmer cannot grow at all, and a turnip farmer will not take from his sheep, and impoverish his land; 2. There would not be straw enough for this extensive stall-feeding upon full turnips; and, 3. He has seldom houses for the purpose.

A farmer of land in Scotland, under the Norfolk rotation, manages his materials, therefore, in the following manner. Supposing that these materials, at the beginning of winter, are—  
200 acres of wheat, barley, and oat-straw.

20 acres of turnip and potatoes, to be eaten in the straw-yard and houses, for the purpose of converting this straw into dung.

20 acres of hay, reserved from soiling and pasture.—The straw,  $1\frac{1}{4}$  ton; turnips, 30 tons; hay,  $1\frac{1}{2}$  ton. Twelve horses, and as many cows or other stock to be housed, and cattle kept in straw-yard, to convert the straw into dung. If he buys a few cattle for fattening, it will only diminish the number of the straw-yard cattle, without affecting the result; and upon such land, he cannot well have a breeding stock of any kind.

As we suppose not more than three-fourths of the straw is converted into dung during the winter months, and that the remainder is reserved for soiling in summer, suppose he buys only 40 stout kyloes, or north-country cattle, for his straw-yard, which he begins to serve with wheat or barley-straw and turnips; his horses and housed cattle, at the same time, get the best oat-straw; the horses having corn, and one feed of potatoes or Swedish turnips, and the cows, &c. a few turnips. All the stock will eat a less or greater quantity of straw, in proportion as they get more or less of turnips, and other food. The straw-yard cattle

being allowed fewer turnips at first than afterwards, must, for a month, or thereabouts, eat a good deal of straw; but when more turnips are afterwards given, as they usually are, and always should be, they eat very little straw. In the four months of November, December, January, and February, and part of March, every farmer in Scotland knows, that with a liberal allowance of turnips, 150 acres, or three-fourths of his straw, may be fully disposed of, by 40 straw-yard cattle, and 24 fed in the house, besides the pigs kept in the straw-yard; this being at the rate of  $2\frac{1}{4}$  acres of straw for each beast, which nearly agrees with what is stated, (p. 411), as the result of the experience of a farmer in Berwickshire. The weight of this straw, at 130 Scotch stones, is 19,500 stones; the total consumption *per week*, for 20 weeks, is 975 stones, which, divided among 64, gives  $15\frac{1}{4}$  stones to each, or about  $2\frac{1}{4}$  stones of 22 lb. *per day* for fodder and litter. After the turnip or potatoes for the horses and cows, &c. are deducted from the 20 acres, there may remain 10 acres, exclusively appropriated to the straw-yards, or one-fourth of an acre to each of the 40 beasts, or  $7\frac{1}{2}$  tons, which for 20 weeks, is 60 stones *per week*, or about  $8\frac{1}{2}$  stones of 14 lb. for each beast daily. The urine from this weight of turnips, it is evident, would saturate by far the greater part of  $2\frac{1}{4}$  stones of straw, and leave probably not a fourth for eating; it being always understood that the cattle have enough of straw to lie dry. Indeed, all this straw would not probably be sufficient, if at least another stone a-day was not added, by the diminished use of it in the houses by the horses and cows. Upon the whole, it may be safely asserted, that not a fourth of the straw is eaten on this plan, and of that certainly the far greater part returns to the dunghill.

Were no straw to be eaten, then hay must be provided for all these horses and cattle, and that without any diminution of turnips, which are always required as the means of converting the straw into dung, and not merely for the sake of the cattle; and even a greater quantity of turnips must be given, as there is more straw, from none being eaten. The horses will eat  $1\frac{1}{4}$  stone of hay daily. The cows, which are not kept merely with a view to manure, must have a greater allowance of turnips, or at least

three-fourths of a stone of hay with the former allowance; and suppose the straw-yard cattle now increased to 50, owing to the greater quantity of straw, have only one-third of a stone, the whole quantity of hay for 20 weeks will be 5700 Scotch stones, which, at 1s. amounts to L. 285, and is the produce of 38 acres. The additional turnips for ten more beasts, required by the increased quantity of straw, to be made into dung, at L. 2, 10s. as before, or L. 25, will advance this to L. 310. This, or something near it, is the *increased* expence of converting 150 acres of straw into dung, by giving hay as fodder instead of straw, and must be paid, 1. By the superior value of the 50 straw-yard cattle; 2. By more labour from the horses, or a saving of corn; 3. by the greater produce of the cows; and, 4. By a greater quantity of dung. All which items would not balance one-third of it. Besides, if 38 acres of hay are used in this way by the middle of March, even though the cattle should be sold soon after, about half as much more would be required before grass, for them and the house stock, or, altogether, 57 acres; and if the remainder, 43, were equally divided between grass cut for soiling, and pasture, the latter of which, to a certain extent, is always indispensable, there would be only  $21\frac{1}{2}$  acres for each, one of which moieties it would be found advisable to retain, for an addition to the stock of hay, in case of a failure of the crop. It is needless to add, that if the expence of converting straw into dung by the use of hay would not be repaid, oil-cake would be a still more losing concern, as it is found in Norfolk.

On the whole, it must always be remembered, that the question is not about fattening cattle, but the best mode of converting straw into dung, and whether cattle eating a small part of the straw, instead of hay, having a liberal allowance of turnips at the same time, is not the best, or at least the most economical system for that purpose, more especially as it enables a farmer to carry on that excellent practice of soiling to a greater extent. The greater number of the farmers in the Lothians, Roxburgh, and Berwick shires, do not breed cattle, but purchase them annually for wintering in the straw-yards; and in this way their straw is made into manure. They purchase cattle, chiefly from

the more northern parts of Scotland, giving them straw and turnips throughout the winter. Some farmers feed for the butcher all the cattle they winter, whilst others sell them to graziers in the spring, at an advance of L. 2 or L. 3 *per* head. The Scotch farmers find that their horses and cows can be fed with good oat-straw in winter, without any material difference in their labour, or milk, and certainly they may well suppose there will be still less difference with lean cattle, who had perhaps never tasted good straw, far less turnips, all their lives. They therefore reserve their hay till spring, and having thus less occasion for a large quantity, than their southern neighbours, *they have a great part of their clover to spare for soiling*, (that most valuable practice), and pasture. At the same time, from the allowance of turnips, there is reason to believe, that not a fourth part of the straw is eaten, and of that probably nine-tenths return to the dunghill. Were they then, upon Mr Young's and Mr Money Hill's plan, to provide hay or oil-cake, they might be justly accused of deviating from the great principle which runs through every part of Scotch farming—*economy*; to which the graziers' prices, and the high rents of grass inclosures, would soon oblige them to return.

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## No. II.

### SOME ADDITIONAL PARTICULARS REGARDING THRESHING-MILLS.

HAVING already given a particular account of the nature and advantages of separating grain from the straw, by means of threshing-mills, it would have been unnecessary to have added any thing concerning that process in this work, if an opportunity had not occurred, since the 7th section of chapter I, "On Instruments of Husbandry," was sent to the press, of examining a

very important and satisfactory detail, of a comparative trial of five threshing-mills, for the purpose of ascertaining the quantity of grain that could be threshed by each.\*

The result of the trial was, that when oats are taken, four horses could thresh, without being overstrained, the following quantities:

	Bolls.	Bushels.
In one hour, - - - - -	5	30
In four hours, - - - - -	20	119
In eight hours, - - - - -	40	238

The number of hands required were as follows:

A feeder, - - - - -	1
A man and woman to hand the sheaves from the mow to the feeder, - - - - -	2
One man to riddle the grain, - - - - -	1
Men to take away the straw from the shakers, and to stack it up in the barn, - - - - -	3
A man or lad to drive the horses, - - - - -	1
	8 †

\* See the account drawn up by J. F. Erskine, Esq. of Mar, in the Farmer's Magazine for May, 1813, p. 178.

† On this subject a correspondent, who is well acquainted with threshing-machines, remarks, that though the number of hands, at the mill in question, might be what is above stated, yet that such is by no means the arrangement of labour at mills in general cases. He says, that the hands usually employed are, two men with a cart, to bring the corn from the stack to the mill loft; one man to feed the mill; two girls or boys to open out the sheaves, and hand them to the feeder; two girls to riddle the threshed corn, and remove the chaff; and two men to build the straw in the barn, after it is threshed or three men if it is carried to the straw-yard. It is unnecessary to make men open out the sheaves, or riddle the grain, seeing that these operations can be done as well, and at one half of the expence, by girls, or women.

It is interesting to compare this result above stated, with the quantity threshed by the flail, which may be done from Mr Erskine's experiments. It appears from a trial made under his directions, that two men threshed 3 bolls 3 firlots Scotch, or  $22\frac{1}{2}$  Winchester bushels, in  $8\frac{1}{2}$  hours; but that if the fanners to clean the corn had been properly driven, the quantity would not have exceeded 3 bolls 2 firlots, or 21 Winchester bushels.\* It was also necessary to employ one woman to riddle the corn. It likewise turned out, that the threshing-mill, from its velocity, driving away more of the refuse, the sample it produced was better and heavier, than from the flail. The result was, that seven men, one woman, and four horses, could thresh and dress about one-third more grain, in one hour, with a mill, than two men and one woman could do in eight hours and a half, and not only with more expedition, but more effectually.

The size of one of the threshing-mills was as follows:

1. Diameter of the horse-course, from centre to centre, 22 feet 10 inches.
2. The horses make in a minute three turns of that course.
3. Revolutions of the feeding rollers,  $37\frac{1}{2}$  times *per* minute.
4. Ditto of the straw-shakers, 30 do. do.
5. Ditto of the drum, - 300 do. do.

It appears that when six horses, instead of four, are employed, they will thresh 192 bushels in four hours, which is at the rate of 32 bushels *per* hour; whereas four horses thresh 150 bushels in four hours, which is 37 bushels *per* hour; consequently, a four-horse power is the most economical size, at least for oats: but

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\* It is a pity that the straw threshed by the flail, had not been passed through the mill, to ascertain what additional quantity of grain would thus have been obtained. An equal quantity of straw, threshed by the mill, ought likewise to have been passed through it a second time, to have seen what quantity of grain remained in it.

where wheat is cultivated in any considerable quantity, a six-horse power is necessary.

It is observed by Mr Erskine, that it is a common fundamental error, to make threshing-mills on too economical a plan, and with machinery too slight to undergo any extra fatigue, which usually happens in the beginning of the harvest, when the straw and grain are in a raw tough state, and much work is required to be performed in a small space of time. Slight mills give way on this pressure of business, which creates great disappointment, and an actual loss is sustained, probably to a greater amount, even in one season, than would have given the mill a proper degree of strength, when it was originally constructed.

The importance of the threshing-mill cannot be better illustrated, than by the following extract from Middleton's Report of Middlesex: 'All the straw which is brought to London is insufficiently threshed to clear it from corn. When wheat is at the highest price, and bread scarcely obtainable, the same inconsiderate waste prevails. Something ought to be done to remedy this great evil, for at present the labourer will not thresh the corn wholly out of the straw, no, *not even when his family are suffering for want of bread.*'\* The meaning of which is, that even when corn is scarce and dear, the labourer will not make greater exertions to thresh it clean.

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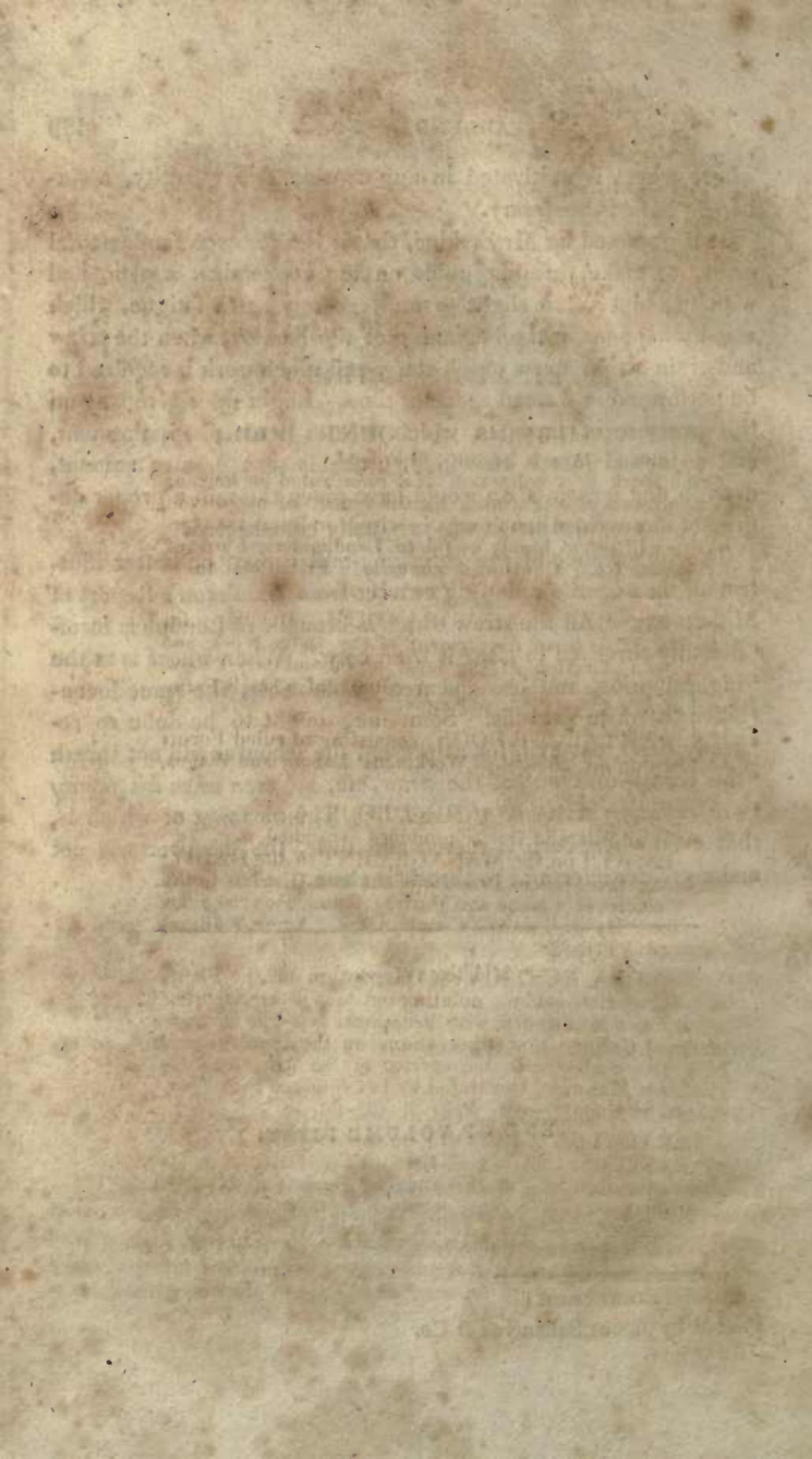
\* Middlesex Report, p. 548.

END OF VOLUME FIRST.

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