On the improvement of poor soils, read in the Holderness Agricultural Society, June 6, 1796, in answer to the following question ; "What is the best method of cultivating and improving poor soils, where lime and manure cannot be had?" With an appendix and notes / by J. Alderson.

AN

ESSAY

ON THE

IMPROVEMENT

OF

POOR SOILS.

Price Two Shillings.

ON THE

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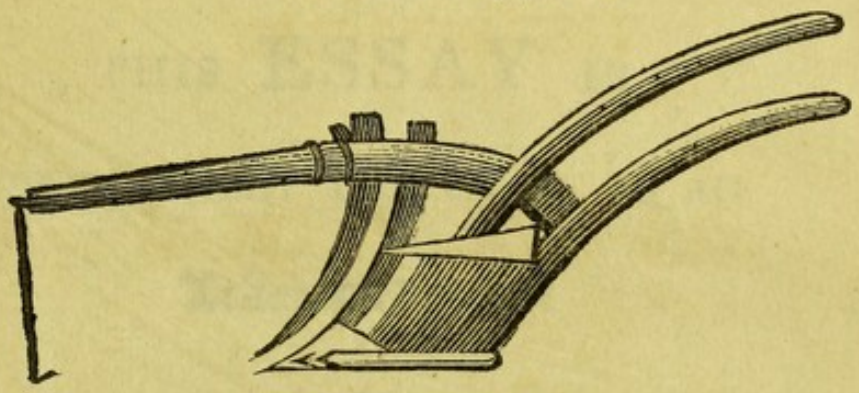
read in the

Holderness Agricultural Society,

JUNE 6, 1796,



In Answer to the following Question;

"WHAT IS THE BEST METHOD OF CULTIVATING AND IMPROVING POOR SOILS, WHERE LIME AND MANURE CANNOT BE HAD?"

with an

APPENDIX and NOTES.

By J. ALDERSON, M. D.

QUID FACIAT LÆTAS SEGETES?

VIRGIL.

HULL:

PRINTED BY W. COWLEY, LOWGATE.

TO THE

PRESIDENT, VICE-PRESIDENT,

AND MEMBERS

OF THE

HOLDERNESS

AGRICULTURAL SOCIETY,

THIS **ESSAY** IS

RESPECTFULLY INSCRIBED AS AN

Acknowledgment

OF THE

PLEASURE AND INFORMATION

RECEIVED AT THEIR

MEETINGS,

BY THE

AUTHOR.

SCULCOATES,
JUNE 1, 1802.

PREFACE.

THE pursuit of agricultural speculations, is amongst the rational amusements of the present age, nor is there any species of literary luxury so truly deserving of indulgence, as that which gratifies itself with a view to the improvement of the country; although every new species of turnip, cabbage, or grass cost more than a substitute might have been bought for, yet the experiment adds to the wealth, the strength, and population of the kingdom; altho' every attempt to increase the produce of the country should barely pay itself, and drilling, dibling, or planting cost as much in labour as they save in seed, yet still will the country be benefited; and the pleasurable feelings excited from year to year, in the breast of those who indulge themselves in such schemes, constitute the highest enjoyment of a rational being.

The following Paper was conceived in the moment of such mental gratification, and the stimulus of similar trains of thinking, has enabled the Author to go through his laborious employment with chearfulness, and often served to fill with pleasure and amusement, the otherwise tedious

hours of many a solitary ride. It has been read in manuscript, by many of the Author's friends, and pleased those, whom He thinks it a credit to have pleased: should its publication excite the attention of any truly ingenuous mind, only till it produce refutation; or induce any one, by experiment, to confirm it; the end the Author had in view in printing it, will be fully answered.

It was read to a large Society of truly valuable Men, who heard it with attention, and received it with all the caution becoming their professional habits. The Appendix was the result of the discussion.

Queſtion.

WHAT IS THE BEST METHOD OF CULTIVATING AND IMPROVING POOR SOILS, WHERE LIME AND MANURE CANNOT BE HAD?

Mr. President,

IN order to obtain real, useful, and practical information, on the subject of Soils; it will be absolutely necessary that our ideas of what Soil is, should be as accurate and precise as possible.

By Soil is generally understood so much of the earth's surface as has been acted upon by the Sun and Air, and impregnated from time to time with the result of vegetable and animal decomposition; but as some plants will grow where no such impregnation has taken place, we shall consider this as *Mould* and define Soil, to consist of certain proportions of the simple earths, of which Naturalists reckon six or seven; and as three of these compose by far the greatest portion, it will be quite sufficient for general purposes,

to note what these three are, *viz.* Chalk, Flint and Clay, with Chalk and Clay every person is acquainted, and the common mode in which Flint affects the Agriculturalist, is in the form of Sand.

All writers and experimentalists have agreed, that not any one of these earths, will separately answer the purposes of agriculture, that is, support the roots and add to the growth of plants; but that, when properly mixed, they certainly do: and according to the best information on the subject, if taken generally, the Soil, when divided into eight parts, ought to consist of the following proportions;—three parts Clay, three Chalk, and two Flint in the form of Sand. This last article will admit of great variations with respect to its fineness or coarseness, according to the nature of the Climate.*

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* That is these proportions will differ according to the quantity of rain that commonly falls in any given place; I need not here enter upon the reasons why more rain does fall in one place more than another; the fact is indubitable, and I recommend the placing rain-gages in different parts of the Country in order that by comparing the result with the experiments now carrying on in other Countries, we may be enabled to ſay what is the best proportion for this district.

Many very plausible reasons have been assigned why this admixture of the earths is necessary for the purpose of forming a good Soil. First, a Soil consisting entirely of Clay would not part with its water sufficiently; Chalk would part with it too fast, and Flint would not retain it at all. Secondly, there are many of the plants we wish to cultivate, whose tender fibres are not able to penetrate Clay; others that will not be sufficiently at rest from the loose and changeable nature of Sand; and others that cannot act upon Chalk: Such and many other reasons may be found in Kirwan. *

If then fertility of Soil depend upon the due admixture of the various earths, we may safely infer that sterility, or poverty of Soil, may depend upon the want of that combination. If land be barren when formed of only one species of earth, let that species be what it will, then will poverty of Soil be in proportion to the superabundance that Soil possesses of any one of the earths.

Experimentalists having then agreed that a due mixture of the earths is necessary to

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* See Kirwan on Manures.

form a fertile Soil, and that barrenness depends on a deviation from the proper proportions, we see the necessity of being precise and accurate in our description of the Soil we call barren.

If I am asked how to improve the poor Soil of a certain field, I should immediately wish to ascertain what the nature of that Soil is; in which earth, it is deficient; and in what it superabounds.

If it be all Clay, then it must have its proportion of Chalk and Sand added, and so on; and where these cannot be had, substitutes may perhaps be found: Thus, stiff Clay soil is made more open in some Countries by burning portions of it in heaps, and then plowing the hardned earth into the land.

If the Soil be sand, which is a frequent source of barrenness in different parts of Suffolk, (where I have seen whole acres of barley blown away,) then Clay becomes useful, and Marl the best possible ingredient. *

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* Common Marl contains from 66 to 80 parts of pure Chalk, the remainder is in various proportions pure earth of Alum and Silex. *Kirwan.*

The following story is an instance of sandy land improved by claying.

An ingenious man having a small property in money, got a grant of some waste sandy land in Shropshire, which till then had been wholly unoccupied. He was allowed to enclose and occupy as much as he could cultivate. Having found near the foot of a hill a stratum of Clay, he by his own labour, carried this Clay and covered the first year an acre of Sand, and then sowed it with grass seeds; These succeeded, and produced a crop of grass: he then went on claying every year more and more of the sand, till he had formed a complete surface of grass on many acres: He then ploughed it up, and last year he had nine quarters of oats *per* acre, upon land which, but seven years ago, would not have maintained a single sheep.

These premises being granted and the facts established on the authority of many and repeated experiments; let us see if any theory can be formed to account for the circumstance, why a mixture of the earths should be better than any single species for the purposes of agriculture.

The changes which take place by the action

of fire in combustion, and those changes which constitute or exhibit animal and vegetable life, have often been compared: Things which support the one, are well known to contribute to the support of the other; and their products are in many instances the same. Now in order to illustrate the present subject, I would carry the comparison further than it has hitherto been done, and I would draw an inference by analogy from the process of fusion, and shew how requisite it is to make a due mixture of earths for the support of vegetable life, from the necessity there is of mixing these very earths in certain proportions in order to render them capable of being acted upon, so as to be chemically combined, by means of fire.

Thus if I put pure Clay, pure Chalk, and pure Flint each by itself into a crucible, and place them separately in the hottest part of my furnace, I cannot alter or change any one of them; they will indeed lose the water or air that was attached to them, but the earths will remain the same, for they are perfectly irreducible; if however I mix them in certain proportions and then apply the same degree of heat, they will liquify, and continue in a fluid state (so long as the fire is kept up) and their particles thus intimately combined will form a mixt mass

with properties distinct from any of the simple earths.

Now the operations of vegetable life resembling, as we said before, the chemical processes of combustion, may not a due mixture of these earths when presented to the mouths or radicles of plants, render them equally capable of being absorbed and converted by the action of the living principle into food, as they are of being fused or rendered liquid by fire? and thus am I not justified by the analogy, to draw this conclusion, that by such an union alone can plants derive nourishment from the earths, for if the contact of these different particles of earth be alone necessary to enable the fire to produce the wonderful difference between the state of a fluid and a solid, is it difficult to be conceived, that the principle of life, so analogous to fire, should be able to exhibit similar effects, in similar circumstances; and, taking advantage of the state of the earths when thus duly proportioned and mixed, be able to absorb and convert them into nourishment? We see here, too, from this theory, the philosophy of plowing, harrowing, hoeing and rolling, operations, so indispensibly necessary to a thorough system of husbandry. Whenever plants have drawn from the Soil, in the neighbourhood in which they are placed, all the materials that happen to

be duly mixed, they are no longer capable of thriving, until by a new operation more particles are brought into contact. This has been sufficiently proved by persons who are in the practice of horse hoeing, and is in effect the very object of those repeated plowings which are performed with the view of preparing the ground for the reception of fresh seed. By this theory we see the reason why Marl becomes so admirable an addition to some soils as to be even called a manure. Marl is nothing more than Clay* and Chalk, so intimately combined that the whole mass is capable of being acted upon by plants, and is formed by the gradual subsidence of these very earths from water that has for a while during floods, rains, &c. suspended them, and I apprehend will be found in this neighbourhood at some future time, when repeated borings shall have given us the exact state of the different strata.†

If I shall have the good fortune to establish this theory, we shall not have occasion to seek for the reason why Chalk renders Clay productive, by supposing that the latter contains an

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* All Clay contains a portion of Sand.

† Vide Kirwin's Mineralogy.

acid * which the Chalk absorbs, for that would be begging the question, as no such acid has been proved, nor shall we have any difficulty in accounting for the different opinions of authors upon the value of Lime, Chalk, &c. as improvers of the Soil; for when the Lime has exerted all its power as a manure, (that is, such of it as has suffered decomposition through the medium of water, in which till it recovers its air it is soluble) the remainder being mere Chalk, mixes with the Soil, and, as it may happen, will be useful or not according to the nature of the ground it is laid upon: Lime may answer to the Farmer as a manure or stimulus, but it can only improve the Soil to the Land-owner, when it is laid upon clay or sandy Soil; and in this view, Chalk, in an equal state of fineness, is equally as valuable as Lime. †

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* See Home, Mills and others.

† The nature of the Lime employed must be attended to according to the nature of the Soil to be improved. Chalk when burnt into Lime contains from 5 to 10 per cent of Sand, whereas some lime stones contain from 50 to 80 per cent; some also contain Magnesia, which, according to Mr. Tennant * is not only not useful in agriculture as an im-

* *Philos. Trans.*

We must never forget that plants contain a living principle; that the action of this principle seems to be analogous to the power which fire has of altering the arrangement of the particles of matter; of elevating some into the form of *gas*, and of rejecting others; and that the final cause of life, in every individual, is to bring together such particles of matter, as when duly acted upon and assimilated, will constitute the essence of each particular living being. Thus from the same nourishment do different living powers produce totally distinct matters, only by new arrangements; and in his laboratory the Chemist, from various and different proportions of the same ingredients, can constitute and produce results, more different, in their properties and appearances, than any two species of plants or animals.

Thus oil of vitriol, balsam of sulphur, and flowers of brimstone, are only composed of different proportions of the same ingredients, yet

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prover of the Soil, but hurtful to vegetable life. Magnesian lime stone may be discovered by the slowness with which it dissolves in acids; and it may be easily detected in Chalk, by adding a sufficient quantity of the vitriolic acid, which uniting with the Magnesia forms the bitter purging Salt very distinguishable by its bitter taste.

they are extremely dissimilar in their outward appearances, in their smell and taste, and action upon all the senses.

The wonderful alterations which the earths undergo when by heat, they run into fusion, become fluid, or rise into vapour, are very similar to the processes of digestion and chylification in the body. Every thing in nature by one process or another, is capable of being converted into aeriform fluids, which in rising from the surface meet, intimately mix, and form new compounds; the same may be affirmed of composts: the intermixture of various matters produces decomposition; particles formerly united are separated, and new arrangements take place.

If this be the case with what is called inert matter, how much more reasonable to suppose it may take place where organic life is concerned.

All the products of nature seem destined to perpetual change and alteration; and the fibrous roots of plants, appear intended by providence, to produce the first stage in the transmutation of inert matter into life. Thus, by decomposition and absorption, earth becomes vegetable; vegetable matter is no sooner decomposed in the stomach of animals, than it is capable of being converted into animal matter; and when farther

eliminated and purified by the delicate organs of the human species, reaches the utmost perfection of created intelligence. *

Having thus generally stated the necessity of a mixture of earths, for the purposes of forming a good soil, and pointed out the reason for that necessity, namely, that by such mixture they can alone be decomposed and taken up as nourishment by plants, which supposition I have endeavoured to elucidate by the analogy of the action of fire; I shall now beg leave to particularize a few things more in answer to the question.

A modern author, who does not seem to have adopted any of the new doctrines of Chemistry, speaks of an oily matter or principle being the food of plants; but oil, as oil, can no more enter the fine vessels of plants, than any one of the simple earths; it must therefore be decomposed and resolved into primary principles or elements, as well as any thing else. Oil may, and probably does, contain a very large portion of some principles, which constitute the chief food of plants in certain stages; but something must be added in order to produce digestion, and assist

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* "And the Lord God formed Man of the dust of the ground. *Genesis* ii. 7."

"For thou exist'st on many a thousand grains"
"that issue out of dust." SHAKESPEARE.

in the decomposition of it, in the same manner, as we have proposed in the admixture of the different earths. Thus alkalies and lime will render oil capable of mixing very intimately with water, and we are thence led to conclude that they may contribute to render it more digestible; or in other words, that they may make it capable of being decomposed, and thus enter and be eliminated as elements of nourishment in the composition of the plants destined to be nurtured.

This doctrine may be farther illustrated by the process which milk undergoes.—Milk, as milk, does not enter into the lacteals of animals; it must undergo decomposition, and be digested as well as any other food, before it can serve the purposes of nourishment.

There are however many other things to be done, and many to be removed, before barren Soils can be made productive, and which may be done where the due admixture of the earths is not to be obtained. There are many things found adapted to particular Soils, the introduction of which may reward the industry of the husbandman, through a particular culture.

With this view particular grasses have been found to thrive on particular Soils, as the Saint-foin on Chalk.

Thistles are capable of deriving nourishment and growing to a large size, where no other plant can exist; and by the exuviæ or remains they leave, and the protection they afford to some plants and many animalculæ, thus tend to ameliorate such soils; but whether these should be suffered to grow to a crop and advantage taken of their product, or ploughed in as manure, is a question which I shall not agitate at present. Spinach may also be tried with the same view, (the prickly kind being the hardiest is to be preferred) the leaves being extremely succulent :* all succulent plants impoverish the ground but little, because they derive a great part of their nourishment from the atmosphere, as may be easily proved from the alœ tribe, which will lie out of the ground for a great length of time without being hurt, drawing their nourishment only from the atmosphere; and certainly these fleshy succulent plants, when ploughed in, will afford a very considerable supply of food for more useful plants.

Buck wheat also, and fumitory, a common weed upon chalky Soils, might perhaps be converted to very useful purposes as a stimulus

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* "All succulent plants make ground fine and of a good quality." Vide Biberg's Œconomy of Nature.

for food; for the latter when burnt, affords an uncommon quantity of the fixed alkali, so well known to be a most powerful stimulus to the growth of plants; and as the poorest Soils may, by a particular management in the use of stimuli, be made to produce a crop, so an alternate crop of such plants with corn, seems to offer as an eligible mode of cultivating poor Soils, where lime and manure are not to be had.*

The planting of forest trees as tending to defend the more valuable plants from the injury they are exposed to in a poor Soil, is an object well worth attention; more particularly on grass land. Some author in the Academy of sciences, has proved, that land exposed to a long current of wind, which blew over a large tract of barren waste, would produce nothing but poor grasses, so long as it remained thus exposed; but when this current was broken by a few hedges and plantations of forest trees, it became capable of propagating and rearing the most useful and prolific plants. Nor is the whole of this good effect absolutely owing to the shelter, mechani-

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* In the 3d. volume of the American Transactions, there is a paper on the cultivation of the eastern shore Bean, for the express purpose of being plowed in as a manure.

cally afforded, but a part to the chemical change produced thereby. Perhaps the atmosphere parts with its electrical matter, which has been found highly conducive to the growth of plants. The shake the air gets by being driven against the hedges and trees, may dispose it to a decomposition highly favorable to its giving out nourishment; and on this principle it is, I apprehend, that the air partially obstructed, as by hedges and trees, always tends more to the amelioration of land, than when stone walls and mud fences are employed.

Planting oziers, as a crop on wet land, is another mode of answering the end proposed in the Question. Lands not worth half-a-crown an acre on the side of the Trent, have been planted with oziers, at the expence of four pounds per acre, and since let for four guineas an acre per annum.

One source of barreness in Soils is an abundance of the calx of iron. The calx or rust of iron may be known by the redness or blueness it gives to most Soils, with which it is incorporated. It may appear extraordinary to many, that this iron should be the result of vegetation; but the fact is incontrovertible. I have reason also to believe, from observation, that particular trees and peculiar plants, are more disposed than

others to produce the mineral earth; and it behoves the improver of the Soil to ascertain, what these plants and trees are, in order to have them if possible removed. Of trees, the willow tribe, alders and others; amongst plants, the whole order of rushes, &c. and above all the rest, every species of moss, most assuredly produce iron, and ought never to be suffered to exist on cultivated land.

The action of water upon Soils in general ought not to be overlooked. Water lying long upon the ground, certainly tends to the destruction of those plants, we wish to cultivate; and it happens with this inestimable fluid, as with many others, that, "too much of a good thing is good for nothing." The reeds and rushes and those plants which tend to destroy soil by producing iron, and which are alone capable of living in water, render the soil poor, not only by their secretions, but by their excretions.

Hence in all countries, contrivances should be resorted to, to carry off the water, when its continuance would produce this effect.

But thousands of acres are barren for want of water; and there are few situations in which

water may not be employed at times, with considerable advantage. In all cultivated hilly countries, no drop of rain ought to be lost, it were better that one acre in twenty were devoted to the reception of what falls, in order that it might afterwards be distributed over the land, than that it should be suffered to escape. *

I am of opinion that in a variable climate, and a cultivated country, like ours, the whole quantity of water that falls from the clouds ought to be employed in agriculture, and not allowed to run on to the ocean, so long as it is capable of serving the purpose of vegetation. I am aware that, in the present state of things, the labour might be greater than the profits; but should Engine work be so far improved, as to reduce the price of labour, and be introduced into practical husbandry, it will then in Holderness, be no very difficult matter to place reservoirs and drains in such a manner, that a whole farm may be either drained or flooded at pleasure.

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* With a double view these catch water drains as they are called, ought to be formed not only to prevent the low lands being flooded during violent rains, but by keeping up the water to preserve it to be employed, at a proper season, in irrigation.

Observe what the Chinese do, who certainly possess the best cultivated country in the world. "They are not content to make canals for the convenience of travellers, but they dig many others to catch rain water, with which they water their fields in time of drought; during the whole summer, you may see the country people busied in raising this water into a number of ditches, which they continue across the fields; in other places they contrive large reservatories made of turf, whose bottom is raised above the level of the ground about it, and if they meet with a spring of water, it is worth while to observe how cunningly they husband it, they sustain it by banks in the highest places, they turn it here and there a hundred different ways, that all the country may reap the benefit of it, they divide it by drawing it by degrees, according as every one has occasion for it, in so much that a small rivulet, well managed, does sometimes produce the fertility of a whole province." *

Considerable expence has been incurred in this country, in order to find the best means of carrying off the water, but sufficient attention has no where been had, with a view to improve

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* Vide Le Compt's Letters on China.

the Soil, by watering. * Much information on this subject may be had by consulting Mr. A. Young's various works, under the article Irrigation; as well as those of Mr. Wright, and others. †

But those whose lands border on the Humber, or the Sea, may derive a further advantage from this vicinity, than what arises from mere irrigation. I have already taken some pains to point out the absolute necessity there is for bringing the different earths into close union, in order to procure that decomposition, necessary to their being converted into vegetable life; the same doctrine is applicable to composts, and may now be extended to salt water.

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* Advantage has not been taken of situations calculated to derive benefit from the springs of the country, the whole of Anlaby and Hessle low lands, at the inclosure, might have been watered at pleasure, by keeping up the spring that passes through Anlaby town; or by boring and piping the springs that may any where be found, and which will rise a foot or more, in most places within those parishes, above the surface.

† Great advantages of late years have been derived from flooding along the course of the Ouse and the Trent, where the land has been regularly raised and a new stratum formed for the purpose of cultivation, by suffering the floods to lie and deposit their mud, then letting them off. But the waters in the Humber are too salt for this purpose without decomposition.

Salt water consists of certain alkaline salts united to the marine acid, which form a neutral not easily decomposable in common earth, and therefore not a very ready manure; to obtain the greatest possible advantage from sea water, it ought to be decomposed, which may in part be effected by adding to it an earthy salt called gypsum, alabaster, or plaster of Paris; a matter compounded of lime and the vitriolic acid; when this is well soaked in sea water, the vitriolic acid will in time quit the lime, sieze the alkaline basis of sea salt, and set the marine acid at liberty, which being extremely volatile will escape; and you will then have lime and a neutral salt that has been found by experiment to be a most excellent manure: * but in all these operations a large quantity of earth or soil, should be compounded with the result before it be applied as a manure; the salts being of themselves too pungent, if applied to vegetation unmixed with earth. This method ought also to be pursued, when any composts are formed.

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* According to Bertholet, Chalk is capable of decomposing sea salt, in the course of four years, and that by that process the natron or alkali is suffered to chrystalize in the lakes in Egypt. *

* *Vide Memoirs on Egypt.*

Sand is also capable of further use than what is merely pointed out by the foregoing theory. In Norfolk it is thrown into the yards and stables, to absorb all the moisture; and the horses and cattle that are fed in the stalls with cutgrass or vetches, are bedded with it, in order that their urine may be absorbed and employed for the future amelioration of the soil.

APPENDIX.

IN answer to those gentlemen in this Society, Mr. PRESIDENT, who have said, there is no Land in Holderness bad enough to grow Thistles upon; I ask, is there no land that requires occasional fallowing? if this be allowed, then the question will be, whether the cultivation of thistles be or be not, more advantageous to the land or productive to the farmer, than letting it lie fallow. Now it having been stated by such authority as Dr. Withering, that * thistles grow and flourish upon Clays, where no other plant can exist

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* "Thistles, as the most useful, are armed and guarded by nature herself. Suppose there was a heap of clay, on which for many years no plant had ever sprung up, let the seeds of the thistle blow there, and grow, the thistles by their leaves attract the moisture out of the air, send it into the clay by means of their roots, will thrive themselves and afford a shade, let now other plants come and they will soon cover the ground."

Biberg's Œconomy of Nature, Translated by Stillingfleet.
See alſo Withering's Botanical Arrangement.

without manure, and that where they have grown, other plants may ever after be propagated; will not a crop of thistles be found highly advantageous to the farmer; * for if they exist upon land and draw none of the common nourishment from it, will not their refuse, when in a state of decomposition, be a valuable addition to the means of support, or at least will it not prove a powerful stimulus to more valuable plants which we may afterwards wish to cultivate upon the same land.

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* "It is probable" says Parkinson "that the Sow-thistle were it properly cultivated, would become one of the most fattening plants the earth produces; Sheep when in clovers, &c. will feed upon it so greedily as to eat the very roots, Pigs likewise prefer it to almost any other green food, Rabbits will breed more speedily when fed with sow thistles, than with any other food I know of, except dandelines which is of the same nature, and is now sold in Covent Garden Market to the breeders of tame Rabbits. A man of my acquaintance who was allowed better skill with stallions than the general part of mankind, used to search for sow thistles to give to his horse. We have a well known and decisive proof of the nutricious properties of sow thistles, in the fat wether Sheep fed to an amazing size by Mr. Trimnel of Bicker Fen, near Boston, Lincolnshire, upon the fen land. This Sheep was bred by Mr. Hutchinson in Hail Fen, from a ram bred by Mr. Robinson of Kirby near Sleaford. He never ate any corn, oil cakes, &c. but

Is it not the final cause of plants to bring dead earthy matter into a state of life? We know that when there is a due mixture of the earths, any plant we wish to cultivate will thrive and produce this effect; and that if we add a sufficient stimulus, or manure, then such plants will yield the largest increase, or even where there is not a due mixture, provided we can supply a large and repeated quantity of the stimulus, that even there, where they would otherwise starve, they may for a season be induced to make vigorous

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fed wholly upon grass and herbage; being turned with many other sheep into a field of clover, this sheep was at first observed to search for Sow-thistles, and would eat no other food whilst any of them could be found in the part of the field, that was hurdled off successively a little at a time; when the field was bare of thistles his attendants gave him three times a day from two to five pounds at a meal. This Sheep when killed measured five feet from the nose to the tail, the rump or cushion eight and a half in depth, plate or fore flank of the same thickness, breast end seven inches, one yard five inches and a half round the collar, and weighed sixty seven pounds a quarter avoirdupoise weight; the legs were estimated at forty pounds each, but if cut haunch of venison fashion would have weighed fifty pounds each, for which the Proprietor, Mr. Lumby, was offered *two Shillings* a pound; so that the legs only would have brought ten pounds.

Vide Parkinson's Experienced Farmer.

shoots and perfect themselves. But in the case of barren Soils, where this due mixture is not present, and where (as the question implies) the stimulus is not to be had, it is the object of our enquiries to find out a plant that will grow, and either yield an immediate profit, or by improving the Soil, enable others more valuable to succeed in future. Now as the Soil immediately referred to is confessedly Clay, and as thistles will grow thereon and will leave behind them such a quantity of refuse as will enable other plants to succeed, ought we not to recommend the cultivation of them on Poor Land, with the expectation that they will add more to the Soil than they take from it, and so become improvers: For if we can find any plant capable of absorbing and converting barren Clay into vegetable matter, and that too without extracting any of the common food of more valuable plants, or requiring any of the usual manure or stimulus; and this plant is capable of affording two or three tons of manure per acre, that will as a stimulus enable other plants to draw nourishment from the same land, it is surely an object worthy the attention of the cultivators of such Poor Soils.*

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* The annual thistles such as carduus natans, acanthoides, marianus, or the common Sow-thistle, sonchus oleraceus are the plants here recommended.

See Hull Advertiser, Vol. 2, No. 62, 63.

The necessity of fallowing seems to be generally admitted in the present state of our knowledge in agriculture; because, say our farmers, a bad crop is worse than nothing.

Land, where there is not an uniform admixture of the earths, or of all its component particles, gives out all the mixt matter capable of affording food to the valuable plants (that the preparatory ploughings have brought together) in a succession of two or three crops; and therefore requires fallowing. in order that the land may be ploughed at all seasons, and receive the most perfect mixture our present instruments are capable of producing: I say our present instruments; for until instruments of husbandry can be contrived to give the land the same degree of mixture, and bring its particles into the same degree of union as grinding in a mill would, farming will not arrive at its utmost perfection.

It is an old farming maxim, that plants of the same species, will not thrive successively on the same land, for where one plant has died another of the same species cannot live. This

is the case with animal life, and with combustion or fire; two processes extremely analogous to vegetation. *

Where a candle becomes extinct (provided no fresh air be admitted) another cannot be lighted, and where an animal has died, another of the same species cannot exist; but other combustible matter may be made to burn, and animals of a different species, may for a time be made to live. Thus I would infer, that where a crop of wheat has grown, been brought to perfection, and died, there another crop of the same kind will not succeed; although a different kind of corn, pulse, or grass may.

Now the reason why the former phenomena take place, is partly by the abstraction or taking away of something from the air, necessary to the life or existence of the first animal or combustible substance, and partly by the giving out something, which (though inimical to the animal that parts with it) is nevertheless (so far from being hurtful to others) the very matter some kinds prefer to live upon. The same or similar processes may go on with plants; where a crop of wheat has grown, the materials for the sus-

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* Vide preceding observations.

tenance of wheat may not only be absorbed, but the situation in which it has lived and died, may be so impregnated with its excretions * as to be inimical to the life of any future plant of the same species, although, as we said before, not for any other kind, until by a proper succession this very matter be attracted and absorbed into the substance of other plants; and thus we are enabled to point out the obvious principles that govern those rotations which the experience of all ages teaches.

The great desideratum or object of our enquiries then will be, what is the best means of bringing together a fresh set of materials remaining in the Soil? and what is the succession best calculated to remove from the Land, the dregs of former crops, or what plants will best live and thrive where others have previously been cultivated. I know it is the general opinion of men of experience, in this part of the country, that fallowing can alone effect the former, and it is the general practice to make the black and white corn succeed each other in order to effect the latter. Let us however enquire a little

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* This Theory may be exemplified by a fact which I here frequently observed; the fibrous roots of thorn and many other trees and plants, where they enter Chalk or Clay, leave behind them an ochre or irony mark.

further; I am aware that the fact (to account for which, I have ventured to frame a theory) has been denied by authority,* long celebrated in agriculture; I mean, "that wheat cannot be made to grow upon the same land, for two or three years successively;" and we are referred to an experiment made in a field belonging to Mr. Barlow, near York, for the proof of the contrary; but what does the experiment say? It says that "plants of wheat were taken from a situation in which they had stood the winter, and transplanted into a field that had grown potatoes; had been afterwards ploughed, harrowed and rolled, and were pricked down an inch deep, and nine inches from each other," and "that it is proposed to do the same for several successive years, in order to determine the doubtful point whether wheat can be raised for a number of successive years upon the same Land;" and "that instead of letting the Land lie waste under a summer fallow, it may be made to produce a crop of cabbages, turnips, pease, beans, potatoes, or summer vetches, as preparatory to its being planted with wheat.—Can this experiment militate in the least against the doctrine here advanced? or does it not rather go to prove the truth of it; for is it not clear

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* Vide Dr. Hunter's Circular Letter.

that in order to succeed, it is necessary by transplantation, to remove the plants from a Soil out of which they have already extracted a certain portion of its nutricious matter, and in which they have already deposited something which might be hurtful, when they came to flower and seed? *

That the plan of transplanting wheat will answer I have not a doubt; it has long been practised by several Gentlemen in Norfolk, and upon the principles here laid down and agreed upon, we can judge how it may prevent the necessity of fallowing, as it goes to prove what I have before hinted at in my Theory, that by sowing a summer crop of leguminous plants, such as pease, beans, vetches, &c. or the useful roots, turnips and potatoes, every thing hurtful to the growth of wheat may be abstracted or taken from the Ground. This however may be perhaps as profitably done by substituting a succession of other white corn, instead of wheat, in a regular manner.

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* Some warp land on the other side of the Humber, produced wheat for seven years, successively, without manure, but this only proves the possibility that earth may be accidentally so well arranged and so easily mixed as to afford nourishment.

From the foregoing, then we are led to conclude, that by attention to a proper mixture of the earths, in order to bring various particles into intimate union, by frequent new combinations, and by a succession of plants dissimilar in their habits from each other, we may so far improve agriculture as to have yearly crops from such a Soil as ours; and that it will be possible, in time, to bring every acre of ground into an almost equal degree of value.

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* There is a practice, frequent in Holderness, which deserves to be reprobated, and that is, suffering stubbles to lie unploughed after harvest. It appears to me a shocking waste of the valuable Soil to suffer it to be exhausted at the latter spring, in producing useless plants and weeds. The great object of agriculture is to take advantage of every circumstance that can oblige the earth to produce only the profitable parts of the vegetable creation; to suffer the Land therefore to support what at present we know not the use of, is in the highest degree injurious and impolitic.

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