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THE  
FARMER'S COMPANION;

OR,

ESSAYS

ON THE PRINCIPLES AND PRACTICE

OF

AMERICAN HUSBANDRY.

WITH

THE ADDRESS,

PREPARED TO BE DELIVERED BEFORE THE AGRICULTURAL  
AND HORTICULTURAL SOCIETIES OF NEW HAVEN  
COUNTY, CONNECTICUT,

AND

AN APPENDIX,

CONTAINING

TABLES AND OTHER MATTER USEFUL TO THE FARMER.

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SECOND EDITION.

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BY THE LATE HONORABLE JESSE BUEL,  
CONDUCTOR OF 'THE CULTIVATOR.'

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BOSTON:  
MARSH, CAPEN, LYON, AND WEBB.

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## P R E F A C E .

My prominent object, in presenting this volume to the public, is to aid in the improvement of American Husbandry. Even he that has received but the one talent, is bound to put it to interest for the benefit of his country. Influenced by this consideration, and the almost total deficiency of books upon American husbandry, for school and rural libraries, I have been induced to send abroad this volume, in the hope, that it will contribute, in some degree, to improve and elevate this primary branch of national industry. Should it be favorably received, I propose to prepare another volume, treating particularly of the management of Tillage Crops, the Garden, the Orchard, &c.

Bred to a mechanical business, I took up Agriculture, more than twenty years ago, from choice, as the future business of my life. Without the pretensions or conceits which we are all apt to acquire in the long practice of a business, I began farming with a consciousness that I had every thing to learn, and that the eyes of my neighbors would be quick to detect faults in my practice. I at once, therefore, sought to acquire a knowledge of the principles of my new business, and of the practice of the most enlightened and successful farmers. These I found in books and agricultural periodicals ; and by these I have been greatly benefited. Although it does not become me to herald my success, I will venture to say, to encourage others, and particularly the young, in the work of self-instruction and improvement, that my lands, which are light and sandy, and which cost, in an uncultivated state, thirty dollars an acre, are now worth two hundred dollars an acre, for farming purposes ; or, in other words, that the net profit of their culture exceeds the interest of two hundred dollars per acre.

I make no pretension to scientific or literary attainments, other than such as men acquire in the active business of life. I write as I think and practise ; and have endeavored to adapt my style to the capacities of common readers. In detailing the operations of the farm, I have endeavored to explain the principles on which these operations are founded. Indeed, so far as my ability would permit, I have endeavored to unite science and art, as I think they ever ought to be united, in all the business of farming of which I have treated.

The great objects of the farmer should be, *to obtain the greatest returns for his labor, without deteriorating the fertility of the soil ; and to restore fertility, in the most economical way, where it has been impaired, or destroyed, by bad husbandry.* It has been my aim to give instruction upon these points, and to explain the principles upon which my recommendations are based, and upon which my individual practice has been founded.

J. BUEL.

*Albany, September, 1839.*

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NOTE BY THE PUBLISHERS.

SCARCELY had the ink with which this volume was written become dry, ere we were called upon to mourn the loss of its intelligent and highly-respected Author, who, while on a mission of good to his Agricultural brethren, was suddenly cut off, in the mid-day career of his usefulness, at Danbury, Con., October 6, 1839, after an illness of a few days' continuance. The high estimation in which he was held, is amply evinced by the expressions of regret for his loss, and of respect for his memory and worth, that have appeared in the public prints throughout the Union. He had long been identified with one of the most important interests of our country, and more recently shone as an ardent advocate of another equally as important interest. After a careful examination of the various projects that have been devised for furnishing School Districts with suitable Libraries, he became fully convinced of the superiority of the Massachusetts plan, and accordingly repeatedly expressed, through the columns of the Cultivator, his decided preference for 'THE SCHOOL LIBRARY' now publishing under the sanction of the Massachusetts Board of Education, and, as a still stronger evidence of his preference, he prepared for the larger Series the present volume.

During the past season, he *compiled* a volume, consisting of selections from the columns of the Cultivator ; permission to print which was by him granted to the Publishers of 'THE SCHOOL LIBRARY,' but they preferring a *freshly* written and *original* work, were favored with this. It was the intention of Judge Buel during the coming winter, to follow this with another work on matters interesting to the Farmer and general reader, but the All-wise Disposer of events has seen fit to order differently, and this volume, therefore, as his last and most important work, must be looked upon as a rich legacy by him bequeathed to the friends of Agriculture and Education, and as an earnest of what, had his life been spared, he would have continued to do, for the advancement of the two interests, for whose success his earnest aspirations were sent up.

A call having been made for this work, the Publishers have been induced to issue the present edition in advance of that designed for 'THE SCHOOL LIBRARY.'

*Boston, November, 1839.*

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# FARMER'S COMPANION.

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## CHAPTER I.

### THE IMPORTANCE OF AGRICULTURE TO A NATION.

THERE is no business of life which so highly conduces to the prosperity of a nation, and to the happiness of its entire population, as that of cultivating the soil. Agriculture may be regarded, says the great Sully, as the breasts from which the state derives support and nourishment. Agriculture is truly our nursing mother, which gives food, and growth, and wealth, and moral health and character, to our country. It may be considered the great wheel which moves all the machinery of society; and that whatever gives to this a new impulse, communicates a corresponding impetus to the thousand minor wheels of interest which it propels and regulates. While the other classes of the community are directly dependant upon agriculture, for a regular and sufficient supply of the means of subsistence, the agriculturist is able to supply all the absolute wants of life from his own labors; though he derives most of his pleasures and profits from an interchange of the products of labor with the other classes of society. Agriculture is called the parent of arts, not only because it was the first art practised by man, but because the other arts are its legitimate offspring, and cannot continue long to exist without it. It is the great business of civilized life, and gives employment to a vast majority of almost every people.

The substantial prosperity of a country is always in the ratio of its agricultural industry and wealth. Commerce and manufactures may give temporary consequence

to a state, but these are always a precarious dependance. They are effeminating and corrupting ; and, unless backed by a prosperous agricultural population, they engender the elements of speedy decay and ruin. Venice, Genoa, Portugal, Spain, &c., each in turn rose to wealth and power by commercial enterprise. But they all now exhibit melancholy evidences of fallen greatness. They have fallen, in succession, from their high standing, victims to the more robust energies of rival powers, or to the enervating and corrupting influence of commercial cupidity. They exhibit nothing now, in their political or social institutions, and but little in their agriculture or in the useful arts, that can be admired or coveted, by the citizens of our free country. Great Britain has now become ascendant in commerce and manufactures, yet her greatness in these sources of power and opulence, is primarily and principally owing to the excellent condition of her agriculture ; without which she would not be able to sustain her manufactures or her commerce, in their present flourishing state, or long retain her immense foreign possessions, or any thing like her present population. Only one third of her inhabitants are said to be employed in agriculture ; yet the labors of this one third, such is the high condition of her husbandry, suffice to furnish subsistence for the whole. Five millions, of all ages, produce annually, from her limited soil, seven hundred millions worth of agricultural produce, averaging about one hundred and forty dollars for each man, woman, and child of her agricultural population. The recently-published letters of the Rev. Dr. Humphrey are so conclusive and so instructive upon this subject, not only in regard to the importance of agriculture to a nation, but as showing the susceptibility of this art of high improvement and great productiveness, that we here quote an extract in illustration of what we have stated.

“ It is the opinion of competent judges,” says Dr. Humphrey, “ that the advances made in the agriculture of Great Britain, during the last seventy or eighty years, are scarcely exceeded by the improvement and extension of its manufactures, within the same period ; and that to



these advances, no other old-settled country furnishes any parallel. That they have been very rapid indeed, the following figures and comparisons abundantly show: In 1760, the total growth of all kinds of grain in England and Wales, was about 120,000,000 bushels. To this should be added, perhaps, 30,000,000 for Scotland—making a total of 150,000,000. In 1835, the quantity in both kingdoms could not have been less than 340,000,000 bushels. In 1755, the population of the whole Island did not much, if any, exceed 7,500,000. In 1831, it had risen to 16,525,180, being an increase of 9,000,000, or 120 per cent. ! Now, the improvements in agriculture have more than kept pace with this prodigious increase of demand for its various productions; for it is agreed on all hands, that the 16,500,000, or rather the 17,500,000, (for more than a million has been added since 1831,) are much fuller fed, and on provisions of a better quality, than the 7,500,000 were in 1755. Nor is Great Britain indebted at all, at present, to foreign markets for her supplies. Since 1832, she has imported no grain worth mentioning; and till within the last six months, prices have been so exceedingly depressed, as to call forth loud complaints from the whole agricultural interest of the country. England is, at this moment, so far from wanting any of our bread-stuffs, if we had them to export, that she has been supplying us all winter liberally from her own granaries; and, according to the latest advices, she has still bread enough, and to spare. Again, it is estimated by British writers, of high authority, that the subsistence of 9,000,000 people costs, in raw produce, no less than £72,000,000, or £8 for each individual, per annum. According to this estimate, the annual product of this great branch of national industry is \$350,000,000 more at present than it was in 1755; which is more than twice the value of the whole cotton manufacture of the country, in 1831. Now if it costs \$350,000,000 to feed the increased population of 9,000,000, then to feed the present population of 17,500,000 must cost near 700,000,000! What an amazing agricultural product for so small a territory! And yet it is the opinion of practical

men of the highest respectability in England, that the raw produce of the Island might be well-nigh doubled, without any greater proportional expense being incurred in its production ; that is to say, 35,000,000 people might draw their subsistence from that one little speck in the ocean ! Now *we* have a territory more than fifteen times as large as the island of Great Britain ; and what should hinder it, when it comes to be brought under no higher cultivation than some parts of England and Scotland, from sustaining a population of five or six hundred millions of people ? This would give to Virginia something like thirty millions ; to Illinois and Missouri, about the same number each ; to New-York near twenty-five millions, and so on in proportion to the other States. I am quite aware that this estimate will be regarded as extremely visionary and incredible, by many of your readers ; but not more so than it would have been thought in the middle of the last century, that England, Scotland, and Wales could ever be made to sustain thirty-five, or even thirty millions.”

A *city* may flourish by foreign commerce—by becoming the carrier of other nations, as Venice and Genoa have once done ;—till foreign aggression, or foreign rivalry—contingencies of no unfrequent occurrence in the history of nations—shall blast its prospects, and reduce it, like the cities we have named, to ostentatious beggary, or consign it, like Tyre, Persepolis, Petra, and other cities of the East, to ruin and oblivion.

A *town* or *district* may flourish by its manufacturing industry, as many have done in ancient and modern times, as long as it can exchange its merchandise for the means of subsistence and of wealth ; but if its dependance for these contingencies is upon foreign lands, its prosperity is unstable. The interchange may be interrupted or destroyed by war, by the want of a demand for its commodities, or a failure in a supply of the necessaries of life.

A *country* can only continue long prosperous, and be truly independent, when it is sustained by agricultural intelligence, agricultural industry, and agricultural wealth. Though its commerce may be swept from the ocean—and

its manufactures perish—yet, if its soil is tilled, and well tilled, by an independent yeomanry, it can still be made to yield all the absolute necessities of life ;—it can sustain its population and its independence ;—and when its misfortunes abate, it can, like the trunkless roots of a recently cut down tree, firmly braced in, and deriving nourishment from, the soil, send forth a new trunk, new branches, new foliage, and new fruits ;—it can rear again the edifice of its manufacturer, and spread again the sails of its commerce.\*

But agriculture is beneficial to a state, in proportion as its labors are encouraged, enlightened, and honored—for in that proportion does it add to national and individual wealth and happiness.

*Agriculture feeds all.* Were agriculture to be neglected, population would diminish, because the necessities of life would be wanting. Did it not supply more than is necessary for its own wants, every other art would not only be at a stand, but every science, and every kind of mental improvement, would be neglected. Manufactures and commerce originally owed their existence to agriculture. Agriculture furnishes, in a great measure, raw materials and subsistence for the one, and commodities for barter and exchange for the other. In proportion as these raw materials and commodities are multiplied, by the intelligence and industry of the farmer, and the consequent improvement of the soil, in the same proportion are manufactures and commerce benefited—

\* Those who labor in the earth, are the chosen people of God, if ever He had a chosen people, whose breasts He has made a peculiar deposit for substantial and genuine virtue. Corruption of morals in the mass of cultivators, is a phenomenon in which no one, nor nation, has found an example. It is a mark set on those, who, looking up to heaven, and to their own soil and industry, depend not on the casualties and caprice of customers. Dependance begets subserviency and degeneracy, suffocates the germ of virtue, and prepares fit tools for the designs of ambition. Thus the natural consequence and progress of the arts, has sometimes, perhaps, been retarded by accidental circumstances ; but, generally speaking, the proportion which other citizens bear in the state to that of husbandmen, is the proportion of its unsound to its healthy parts, and is a good enough barometer, whereby to measure its degree of corruption.—*Jefferson.*

not only in being furnished with more abundant supplies, but in the increased demand for their fabrics and merchandise. The more agriculture produces, the more she sells—the more she buys ; and the business and comfort of society are mainly influenced and controlled by the results of her labors.

*Agriculture, directly or indirectly, pays the burdens of our taxes and our tolls,*—which support the government, and sustain our internal improvements ; and the more abundant her means, the greater will be her contributions. The farmer who manages his business ignorantly and slothfully, and who produces from it only just enough for the subsistence of his family, pays no tolls on the transit of his produce, and but a small tax upon the nominal value of his lands. Instruct his mind, and awaken him to industry, by the hope of distinction and reward, so that he triples the products of his labor, the value of his lands is increased in a corresponding ratio, his comforts are multiplied, his mind disenthralled, and two thirds of his products go to augment the business and tolls of our canals and roads. If such a change in the situation of one farm, would add one hundred dollars to the wealth, and one dollar to the tolls of the state, what an astonishing aggregate would be produced, both in capital and in revenue, by a similar improvement upon 250,000 farms, the assumed number in the State of New York. The capital would be augmented 25 millions, and the revenue two hundred and fifty thousand dollars per annum.

*Agriculture is the principal source of our wealth.* It furnishes more productive labor, the legitimate source of wealth, than all the other employments in society combined. The more it is enlightened by science, the more abundant will be its products ; the more elevated its character, the stronger the incitements to pursue it. Whatever, therefore, tends to enlighten the agriculturist, tends to increase the wealth of the state, and the means for the successful prosecution of the other arts, and the sciences, now indispensable to their profitable management.

*Agriculturists are the guardians of our freedom.* They are the fountains of political power. If the foun-

tains become impure, the stream will be defiled. If the agriculturist is slothful, and ignorant, and poor, he will be spiritless and servile. If he is enlightened, industrious, and in prosperous circumstances, he will be independent in mind, jealous of his rights, and watchful for the public good. His welfare is identified with the welfare of the state. He is virtually fixed to the soil; and has, therefore, a paramount interest, as well as a giant power, to defend it, from the encroachment of foreign or domestic foes. If his country suffers, he must suffer; if she prospers, he too may expect to prosper. Hence, whatever tends to improve the intellectual condition of the farmer, and to elevate him above venal temptation, essentially contributes to the good order of society at large, and to the perpetuity of our country's freedom.

*Agriculture is the parent of physical and moral health to the state*—it is the salt which preserves from moral corruption. Not only are her labors useful in administering to our wants, and in dispensing the blessing of abundance to others, but she is constantly exercising a salutary influence upon the moral and physical health of the state, and in perpetuating the republican habits and good order of society. While rural labor is the great source of physical health and constitutional vigor to our population, it interposes the most formidable barrier to the demoralizing influence of luxury and vice. We seldom hear of civil commotions, of crimes, or of hereditary disease, among those who are steadily engaged in the business of agriculture. Men who are satisfied with the abundant and certain resources of their own labor, and their own farms, are not willing to jeopard these enjoyments, by promoting popular tumult, or tolerating crime. The more we promote the interest of the agriculturist, by developing the powers of his mind, and elevating his moral views, the more we shall promote the virtue and happiness of society.

The facts which are here submitted must afford ample proof, that agriculture is all-important to us as a nation; and that our prosperity in manufactures, in commerce, and in the other pursuits of life, will depend, in a great

measure, upon the returns which the soil makes to agricultural labor. It therefore becomes the interest of every class, to cherish, to encourage, to enlighten, to honor, and to reward those who engage in agricultural pursuits. Our independence was won by our yeomanry, and it can only be preserved by them.

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## CHAPTER II.

### THE IMPROVEMENT OF OUR AGRICULTURE PRACTICABLE AND NECESSARY.

To render agriculture more productive, and beneficial to all, it is necessary that its principles should be better understood, and that we should profit more from the experience of each other, and by the example of other countries which excel us in this great business. It is true of the manufacturing and mechanic arts, that our citizens do profit greatly by the improvements which have been made, and are continually making, in these arts, whether in Europe or in America. If an improvement, tending to economize labor, to simplify manipulation, or to produce certainty in results, is this year made in any part of Europe or America, in these arts, it is known,—it is adopted, and it profits the artisans and the manufacturers of our country, in the coming year. Thus the improvements of the civilized world, in the manufacturing and mechanic arts, are made subservient to our use in the short space of a twelvemonth. Is it so with agriculture? We are sorry to say it is not. Mr. Coke, one of the most enlightened agriculturists of this or any other age, who has been the means of converting a large sandy, and comparatively barren district, into one of great productiveness and wealth, has said, that his agricultural improvements, and they have been manifestly great, have hardly extended around him more than at the rate of three miles a year,—such have been the prejudices, and such the ignorance of the agricultural population. It is from these causes—

the want of better knowledge, and the lack of means of disseminating it—that our agriculture ranks so low in the public estimation—that every young aspirant for fame and fortune, turns from this pure source of independence and happiness with derision, and seeks for higher enjoyments—for fame and fortune—in pursuits which, alas ! often disappoint his hopes, and which add little or nothing to the promotion of the public good.

Yet agriculture may be rendered as progressive in improvement, as profitable and as honorable, as any of the other arts of productive labor—and more independent than any other employment, if the agriculturist will employ the same means to enlighten his mind, and improve his practice, which the artisan and the manufacturer, and others employ. He lacks neither the means nor the natural capacity for improvement ; and there is no business susceptible of greater enlargement, in the elements of human happiness, than the one he pursues. We possess a soil, prolific in the riches and blessings of a wise and beneficent Creator, who has spread around us all the elements of happiness. HE has given to us capacities for applying these elements for our own good, and the good of others. HE has commanded us to exercise these capacities, in the use of these means,—and HE has promised to reward—and HE does bountifully reward—all who prove faithful to his command.

Let us here stop and inquire, what our agriculture is, and what it may and should be. Generally speaking, our practice is bad. Its tendency is to exhaust the soil of its natural fertility—to render the products of our farms less and less annually—until they become too poor to support our families, or pay us for our labor,—until hundreds and thousands are obliged either to sell out, for a nominal consideration, and to resort to new and unexhausted soils, to retrieve their fortunes, or to sink their patrimonial estates, and to sink themselves and their families to indigence and want. To illustrate what we here state, in regard to the defective condition of our husbandry, and to show the causes which have operated to produce it, we beg to introduce an extract, from a highly-distinguished statesman

and farmer, the Honorable James M. Garnett, of Virginia. In a letter to the writer of this essay, in reply to some queries that had been addressed to him, he remarks :

“Your first question is, ‘Have not successive crops of wheat, of corn, of tobacco, greatly deteriorated some of her once fertile soils?’ [alluding to Virginia.] And your second is like unto it—‘Have they not reduced thousands and tens of thousands, of her good acres, to comparative sterility—to unproductive commons?’ To both I reply—that we have, alas! *hundreds of thousands* of once good acres long ago reduced to ‘comparative sterility,’ but not to ‘unproductive commons;’ for they still produce what we call hencgrass, broom-straw, and, ever and anon, a starveling pine or cedar bush—the reproachful and melancholy mementoes of ancestral improvidence. But the successive crops to which you ascribe this, are far from being the *only*, or the chief causes of the lamentable fact. From the first settlement of the country, until within a few years past, the most deadly enemies to good husbandry, in Virginia, have been—the *utter neglect of it as a science*;—the *implicit adoption, by each successive generation, of the PRACTICES OF THEIR FOREFATHERS*;—the *almost total neglect of MANURES—except for gardens*;—the *incessant alternate cropping and grazing our lands without rest*;—the *culture of them in a certain rotation of workings without a due regard to the condition of the soil, as to wetness or dryness*. But, above all, to the proprietors of this goodly soil generally using it more as the means of gratifying their appetites—their love of show, and the means of displaying it, than as sources of future comfort, respectability, and happiness to their children, as well as of credit and honor to their native State. The acme of ambition, in the olden time, seemed to be, who should have the best cheer, and the most company to consume it—with little or no regard to the ‘material’ of which it was composed; provided these ‘Nate consumera fruges’ were lovers of, and tolerable contributors to, fun and frolic. As long as the plantation held out in furnishing the means of this ruinously-merry career, the troublesome study and prac-



tice of good husbandry were postponed, like the study and practice of religion, '*to a more convenient season.*' This, sir, I sincerely believe, is a true and just explanation of the complicated causes which have contributed to impoverish a vast portion of our lands, and much to my shame and sorrow have I given it. But I have the consolation to feel assured, that the dawn of a much better state of things,—at least in regard to husbandry,—is now shining in almost every part of our old State. I fear to inquire how much is owing to the absolute necessity of reform—how much to motives every way laudable, and shall therefore content myself with the fact. There is, however, *one* cause of the happy change with us, in regard to the efficacy of which I feel so perfectly confident, that I cannot omit to mention it. This is—the circulation among us, of our friend Ruffin's Farmers' Register and your Cultivator,\* which have done more than every thing else towards it. Both are read by great numbers of our brethren, and have greatly contributed to awaken them to a true sense of the vast losses they have sustained by their long and destructive neglect of the study and practice of agriculture."

Let not the Northerners take credit to themselves from this outline of old Virginia husbandry, or from the ingenuous detail of the causes which brought it to so low a condition. Though not exactly the like causes have operated, the same deteriorating system of husbandry has prevailed with us, though perhaps to a more limited extent. Though we have personally attended more to the art—to the practice—yet we have been equally deficient in the science with our brethren of Virginia—equally indifferent to the study and application of the principles upon which good husbandry must ever be based. And although we may have begun earlier in the business of reform, whether from necessity or from choice we will not say, we are still too defective in practice to boast of our trivial acquirements. Neither let him boast too soon who is now luxuriating upon the fertile soils of the west, the ac-

\* At the date of this remark, nearly two thousand copies of the Cultivator were circulated in Virginia.

cumulated treasure of ages, and, in too many instances we fear, exhausting that fertility which of right belongs to coming ages. Like causes will produce the same effects in the west, that we now deplore in the east. The ocean would in time become exhausted, were it not for the streams which are constantly flowing into its bosom. The soil will become barren by constant cropping, unless we give back to it some of the fertilizing matters, which crops are continually taking from it.

The truth is, we have regarded the soil as a kind mother, expecting her always to give, give, without regarding her ability to give. We have expected a continuance of her bounties, though we have abused her kindness, and disregarded her maternal admonitions. We have managed the culture of the soil as a business requiring mere animal power, rather than as one in which the intellect could be brought largely to co-operate. We have not gone into the principles of science—of cause and effect—the laws of Nature, which are certain and immutable, and which must ever have a controlling influence over the soil and its manifold productions. Like prodigal sons of wealth, we have gone on recklessly wasting the treasures intrusted to our care, for the use of coming generations.

But there is a redeeming spirit abroad. The lights of science are beaming upon the agricultural world, and dissipating the clouds of superstitious ignorance which have so long shrouded it in darkness. The causes which have for some time been actively operating to improve the condition of the other arts, and to elevate the character of those who conduct them, are extending their influence to agriculture. A new and better system of husbandry is coming into vogue, which has already been productive of great good, and which promises many new comforts and blessings to ourselves and children.

## CHAPTER III.

## SOME OF THE PRINCIPLES OF THE NEW HUSBANDRY.

THE new system of husbandry is based upon the belief, that our lands will not wear out, or become exhausted of their fertility, if they are judiciously managed ; but, on the contrary, that they may be made progressively to increase in product,—in rewards to the husbandman, and in benefits to society, at least for some time to come. It regards the soil as a gift of the beneficent Creator, in which we hold but a life estate, and which, like our free institutions, we are bound to transmit, UNIMPAIRED, to posterity.

The principles of the new husbandry teach, that the soil is the great laboratory for converting dead into living matters—the useless into the useful—manure into plants—plants into animal food : That plants, like animals, are organized beings ; that is, they live, grow, and require food for their sustenance—have organs to take in food, to elaborate it, to transmit it through their systems—organs of sexual intercourse, of reproduction, &c., all acting together to one end : That plants cannot, any more than animals, live upon mere air, or earthy matters, as clay, sand, and lime, but that they require, for their growth and perfection, animal and vegetable matters : That the effect of growing and carrying off the ground successive crops, is to exhaust the vegetable food in the soil ; and that continued cropping will ultimately render it barren and unproductive, unless we return to it some equivalent for what we carry off.

The principles of the new husbandry also teach, that by carefully saving, and suitably applying, all the fertilizing matters afforded by the farm ; by an alternation or change of crops, and by artificially accelerating or retarding the agency of heat, moisture, air, and light, in the process of vegetable growth ; by draining, manuring, ploughing, harrowing, hoeing, &c., we may preserve, un-

impaired, the natural fertility of our soils ;—and that, with the aid of improved implements of husbandry, and a good system of management, we may also greatly increase the profits of its culture.

These principles do not rest upon mere theory. They have been long reduced to practice, thoroughly tested, and their correctness amply verified. They have, in their practical application, virtually converted Flanders into a garden, and rendered it so fertile in human food, that each acre is said to be capable of supporting its man. The system which these principles inculcate, has changed Scotland, in a little more than half a century, from comparative sterility and unproductiveness, into one of the richest and most profitable agricultural districts in Europe. It has increased the products of the corn harvest, in Great Britain, in sixty years, from 170 to 340 millions of bushels. It has doubled, trebled, and quadrupled the agricultural products of many districts in our own country. It has augmented the value of farms, in some of these districts, two, three, and four hundred per cent.—from twenty and thirty dollars, to one hundred dollars and more per acre. It has made every acre of arable land, upon which it has been practised ten years, and lying contiguous to navigable waters or a good market, worth at least one hundred dollars, for agricultural purposes.

We will state some cases of comparison, between the products of the old and new system of farming, to illustrate more fully the advantages of the latter.

The average products in Flanders are stated by Radcliffe as follows : wheat 32 bushels, rye 32 $\frac{1}{4}$ , oats 52, potatoes 350, per acre. Flanders has generally a flat surface, with a light, sandy soil, illy adapted to wheat. It is naturally very similar to the sandy district upon the sea-coast in New Jersey, Maryland, and the sandy plains in the valley of the Connecticut.

In the fertile districts of Scotland, according to Sir John Sinclair, and in propitious seasons, “the farmer may confidently expect to reap, from 32 to 40 bushels of wheat ; from 42 to 50 bushels of barley ; from 52 to 64 bushels of oats, and from 28 to 32 bushels of beans,

per statute acre. As to green crops, 30 tons of turnips, 3 tons of clover, and from 8 to 10 of potatoes, per statute acre, may confidently be relied on. In favorable seasons, the crops are still more abundant." Professor Lowe gives the average products of Scotch husbandry somewhat lower than the above. It is to be remembered, that, sixty years ago, the average was probably not one quarter as much as it is now.

Loudon states the average product of wheat in England, at 24, 28, and 32 bushels per acre—mean average 26 bushels.

The preceding references are made to old-settled countries—to lands which have been under culture for many centuries—to lands which were once worn out by bad husbandry, but which have been renovated and rendered highly productive by the new system.

In 1790, General Washington, in a letter to Arthur Young, computed the average crop in Pennsylvania, then one of the best wheat-growing States, as follows :—wheat 15 bushels, rye 20, barley 25, oats 30, Indian corn 25, potatoes 75. Mr. Strickland, who resided in Maryland about forty years ago, in a report which he made to the British Board of Agriculture, gave the average product of our wheat crop at 12 bushels the acre, and of Dutchess county, then, as now, our best cultivated county, at 16 bushels.

Bordley, about the period we are referring to, stated the average yield of Indian corn, on the Eastern Shore of Maryland, at 15 bushels per acre.

These quotations are sufficient to show, that in our old-improved districts, the crops do not in any wise compare with those grown in Flanders, Scotland, and England,—and this difference in product is owing entirely to the different modes of managing the soil; for wherever the new system has had a fair trial among us, it has been as successful as it has been in Europe.

We will illustrate still further the difference between the two systems, by stating the products, or their value, on the same lands, under the old and under the new systems of husbandry.

We are furnished, in Rees's *Cyclopedia*, with many statements, demonstrating the superiority of the new over the old system. We will quote some of them. The first comparison is made on a farm devoted to grazing, breeding, and tillage, of 314 acres, in Yorkshire. Under the old mode of husbandry, the nett profits amounted to £316 10s. ; under the new system the same lands gave a nett profit of £596, making a difference of £278, or nearly one hundred per cent., in favor of the new system. The second is that of a tillage farm of 139 acres in Lincolnshire. Under the old system the profits were £130—under the new £452 ; difference in favor of the latter £322, or 250 per cent. The third statement exhibits the profits of an acre of land, being the medium of a farm of several hundred acres, in Yorkshire, for six years. Under the old system the profit was £1 9s. 3d.—under the new £17 6s. 9d.—an increase of more than 1100 per cent. The medium value of the acreable profit in England is stated at from 27 to 36 dollars per annum.

We have spoken of Mr. Coke as one of the best farmers of the age. He owns a large estate in Norfolk, England, a portion of which he has been personally improving for half a century, the residue being occupied by tenants. The rental upon his estate has risen, in fifty years, in consequence of the improvement in husbandry which he has introduced, from £5,000, to £40,000.

The Hoffwyl Agricultural School farm, in Switzerland, under M. Fellenburgh, comprises 214 acres. Lord Brougham, often visiting this farm, and making inquiries of the Principal, says he found that the average annual profit of the pattern-farm alone, for a period of four years, amounted to £886 sterling, equal to about \$4,000, exclusive of the cattle concern, which was kept separate.

The last case we will cite abroad, is that of the farm belonging to the Agricultural School of Moegelin, in Prussia, under Doctor Von Thaer. The school was established in 1809. In twelve years the value of the farm was increased from 2,000 to 12,000 rix dollars, by the improved mode of cultivating it.

The cases we have quoted, we admit to be extraordi-

nary ones ; yet they are not without parallels in our own country. Agriculture has been in a state of progressive improvement in the valley of the Hudson, for thirty and forty years. The lands have been increasing in value in consequence. The change has been so great in some districts, that farms which twenty years ago were sold for 20 to 25 dollars an acre, have recently been sold for 100 to 120 dollars an acre ; and in other cases, particularly on Kinderhook plains, farms which were bought thirty years ago at five and ten dollars an acre, have lately commanded sixty and seventy dollars. Few farms of tolerable land in Dutchess, Orange, or other river counties, contiguous to the Hudson, can now be bought at less than from 100 to 150 dollars an acre, in consequence of their increased productiveness, caused by improved husbandry.

Doctor Black has demonstrated, in his prize-essay, published in the *American Farmer*, that every acre of arable land in New Jersey, which now sells at from ten to thirty dollars per acre, is intrinsically worth five hundred dollars per acre ; that is, if put under a judicious system of husbandry, every acre may be made to yield a nett profit of thirty dollars per annum, equal to the interest on five hundred dollars, at 6 per cent. And Mr. Johnson, of Maryland, in a speech which he made in Congress in 1837, cites a case in Delaware, near Dover, where land was bought, a few years ago, of medium quality, at thirty dollars an acre, by Messrs. Sipple and Peunewell, which has paid in its product for all outlay in improvement, and the owners are now receiving, in the farm-crops which it gives, an annual clear income equal to the interest of *five hundred dollars an acre*.

We will offer but one other illustration in support of the great superiority of the new husbandry. It is that of John Robinson, Esq., an intelligent, industrious Scotch farmer. Fifteen years ago, Mr. Robinson bought a farm on the banks of Seneca Lake, three miles from Geneva, at ten dollars an acre. The farm was considered *worn out*. Mr. Robinson, with the aid of sheep, lime, manure, and good husbandry, has made it produce,

over and above the expense of culture, and the support of his family, an annual income equal to the interest of one hundred and fifty dollars an acre,—and the farm is still in a state of progressive improvement. The income from 400 acres is now \$4000. Mr. Robinson has refused \$100 per acre for the whole.

We might multiply instances of worn-out lands being brought into a highly productive and profitable state, by the new husbandry, were it necessary ; but almost every old-settled district furnishes examples in point. Enough has been shown, or may be seen, to justify us in saying, that, under the new system of husbandry, every acre of arable land, if any where contiguous to navigable waters or a good market, may in a few years be made to yield a nett annual profit, equal to the interest of two hundred dollars. And we may add, that with such an income, and the industry and economy which belong to republican habits, there are few employments in life better calculated than agriculture to render a man independent in circumstances and in mind, and rich in all the elements of substantial happiness.

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## CHAPTER IV.

### AGRICULTURE CONSIDERED AS AN EMPLOYMENT.

EVERY provident parent is anxious to see his children settled in some business of life, that promises to confer wealth and respectability ; and every young man, who aims to arrive at future and honorable distinction, is anxious to select that employment which is most likely to realize his wishes. It is with a view to enable both parent and son to act wisely in this matter, that we propose to point out some of the advantages which agriculture holds out to those who embark in its pursuits.

We propose to consider agricultural employment under the following heads :—

§ 1. As a means of obtaining wealth ;



§ 2. As promotive of health, and the useful development of the mind ;

§ 3. As a means of individual happiness, the great pursuit of life ;

§ 4. As a means of enabling us to fulfil the high objects of our being ;—of performing the duties which we owe to our families, our country, and our God.

§ 1. *As a Means of obtaining Wealth,*

Adequate to our wants, and to all the beneficial purposes of life, agriculture certainly holds a pre-eminent rank. With that industry and prudence, which Providence seems to have made essential to human happiness, and that knowledge which we all have the means of acquiring, its gains are certain, substantial, and sufficient—sufficient for ourselves, for the good of our children, and the healthful tone of society. It does not, we admit, afford that prospect of rapid gain, which some other employments hold out to cupidity, and which too often distract and bewilder the mind, and unsettle for life the steady business habits of early manhood ; yet neither does it, on the other hand, involve the risks, to fortune and to morals—to health and to happiness—with which the schemers and speculators of the day, who would live by the labor of others, seem ever to be environed. Great wealth begets great care and anxiety, and is too apt to engender habits unfriendly alike to the possessor and to society. Wealth that comes without labor, is often wasted without thought ; but that which is acquired by toil and industry, is preserved with care, and expended with judgement. The farmer, therefore, who secures an annual and increasing income by his industry, though it be small in the outset, is much more likely to become ultimately rich, not only in dollars and cents, but in all the substantial elements of happiness, than the man of almost any other profession in life.

We have shown that farm lands have been made to produce an annual income of thirty dollars an acre ; and have said, that by good husbandry they may certainly be made to produce a nett income of fourteen dollars an

acre. Now, if a farmer, upon a hundred acres of land, can save fourteen hundred dollars a year, to buy superfluities for his family, educate his children, and to add to his capital, he must, at the end of twenty years, be either a rich man or an improvident one ; and if improvident, he will probably remain poor, be his employment what it may. But suppose the nett income of a farm should be but half, or a quarter of the sum we have assumed—that is, \$7, or \$ 3,50, an acre ;—even this income, prudently managed, will in a few years place the possessor in independent circumstances.

§ 2. *As promotive of Health and the Development of the Mind.*

The grand requisites to health, or rather for the prevention of diseases, are declared by Dr. Johnson, one of the highest medical authorities of the age, to be—*exercise in the open air—temperance in our living—moderation in our pleasures and enjoyments—restraint on our passions—limitation to our desires, and limitation to our ambition.\**

What employment is there in life, so highly favorable to all the benign influences of exercise—so conducive to repose and tranquillity of mind—and which has so few temptations to intemperate enjoyments—as that of agriculture. And the only ambition which is likely to obtrude upon the farmer, and this is in no wise, we believe, prejudicial to the health either of his body or his mind—is the ambition of increasing the prolific properties of the soil, whereby he may benefit himself and society. Political ambition, which, like a cancer, is apt to prey upon and corrupt the mortal upon whom it fixes its fangs, abides not upon the farm ; at least it should not abide there—for that farmer must be either weak or unfortunate who is willing to give up the certain and tranquil pleasures of a rural home, for the vexing, precarious, and corrupting cares and responsibilities of political eminence, otherwise than as duty may require it at his hands. “ Horticulture and agriculture are better fitted for the promotion of health

\* Economy of Health.

and of sound morals," says an eminent medical author,\* "than any other human occupation." The business of agriculture is one of exercise in its most approved forms; It brings into healthful action the entire muscular system; and when exercised with prudence, as all employments should be, it insures appetite, digestion, sleep, a sound constitution, and a contented mind. "The declaration is as trite as it is true, that exercise promotes virtue, and subdues the storms of passions."†

Although the garden and the farm may be made to furnish a great many delicacies and luxuries for the table, yet these delicacies and luxuries are such as conduce alike to health and to rational pleasure. It is a remark of St. Pierre, that every country and every clime furnishes, within itself, the food which is best fitted for the wants of the animals which dwell in it. The same remark, with a trifling modification, will apply to the farm. The products of the farm and garden *do* constitute the best food for the farmer; and there is no class who can indulge in a greater variety of native products, or enjoy them in a higher state of freshness and perfection, than those who grow them. And upon the farm, and among an intelligent rural population, the pleasures of social intercourse are not curtailed by the cold formalities, nor taxed by the extravagant folly, of the town and city. The agriculturist relies upon his own resources—upon his industry and the blessing of Providence, for the enjoyments of life. His farm and his family are the special objects of his care, and his ambition is to obtain good crops, a good name and reputation in society, and to deserve them, by a liberal and kind deportment to all around him. He is exempt from a crowd of evils—of rivalships and jealousies—of corroding cares and feverish anxieties—which not unfrequently hang around other professions, mar the pleasures of life, and undermine health. He should hate no one; for he should dread no rivals. If his neighbor's field is more productive than his own, he borrows a useful lesson. If his own field is the most productive, it

\* Dr. Caldwell, Prof. Med. Dep. Transylvania College, Ky.

† Dr. Harris, Philadelphia, on Physical Culture.

affords him pleasure to benefit his neighbor by his example. He learns to identify his own, with the prosperity of his neighborhood and of his country.

“Exercise is the universal law of improvement for the faculties of the mind, as well as of the powers of the body.”\* “The profession of agriculture is more favorable to the entire developement of the human faculties ; to the unfolding and perfecting of this physical, this intellectual, this moral and immortal being, which God has given us, than any other employment. It imparts vigor to the body and to the mind, leaving the soul free from feverish excitements, to imbitter, as it were with its growth, the lessons which Nature teaches ; in fine, it is capable of ministering, most successfully of all arts, and of all occupations, to wealth, to intelligence, and to virtue.”†

And what an expansive field is ever before the eye of the agriculturist, for study, for reflection, for usefulness, for the enjoyment of rational happiness ! The book of Nature, replete with the teachings of Divine Wisdom, always lies open before him !

The elements are subservient to his use ; the vegetable and animal kingdoms are subject to his control ! And the natural laws which govern them all, and which exert a controlling influence upon his prosperity and happiness, are constantly developing to his mind new harmonies, new beauties, perfect order, and profound wisdom, in the works of Nature which surround him. Nor need he, in these studies of usefulness, be restricted to his own personal observation. He may call to his aid, both in the prosecution of his business, and the improvement of his intellectual faculties, the counsels of eminent men of every age and every country, who have left for our use the record of their experience and their wisdom. And we say it without qualification, that there are few professions in the community, which give more leisure for general reading, or whose employments embrace a greater scope of *useful* reading, than the business of agriculture. The artisan is generally obliged to employ his winter evenings in labor ; and those

\* Wild's Report on Manual Labor in Literary Institutions.

† Canadian Quarterly Agricultural and Industrial Magazine.

engaged in the liberal professions, and in mercantile business, are not only accustomed to do the like, but their study is in a measure restricted to their particular calling. The agriculturist, on the contrary, may devote his evenings, or most of them, to study—to the improvement of his mind—to the acquisition of useful knowledge. He may devote three hours out of the twenty-four to study, without infringing upon his necessary business, or fatiguing his mind, or impairing his health. This is allowing eight hours for sleep, ten for labor, and three for contingencies. What profession is there, which, if well conducted, gives a larger portion of time to the acquisition of general knowledge? And what a scope of usefulness may be embraced by these studies! The properties of the soils which grow his bread and meat—their adaptation to particular crops—the cause of their deterioration—the modes of renovating or increasing their fertility—by farm manures, by lime, gypsum, marl, and by admixture of earths; by draining, irrigation, and alternating crops:—the animals which are consigned to his care—their form, internal structure, appropriate management; the nature, cause, and cure of their diseases; the various foods most profitably raised for the nourishment of the different kinds; and the best modes of preparing and feeding it:—the crops which he cultivates—their relative value, their habits, proper succession, exhausting influence upon the soil, and the best modes of their management:—the agency of air, heat, light, and moisture in preparing vegetable food, in the processes of vegetable nutrition and development, and the means of accelerating or retarding their agency; all these are matters which come specially within the province of the agriculturist. The more knowledge he has in these matters, the more likely he is to succeed. His unaided observation and experience may do much; yet if to his own, he can add the observations and experience of hundreds of others, in his particular business, as observing and intelligent as himself, he must certainly be able to profit greatly by it, and to advance in improvement.

Labor is in no wise incompatible with study; but, on

the contrary, it is necessary, or exercise is necessary, to the developement of the faculties of the mind ; and where study and labor are directed to the same object, as they may be in agriculture, they tend particularly to stimulate, and to give pleasure and profit to each other. Many of the most eminent and useful men in the improvement of society have been such as have prosecuted their studies while daily laboring in their professional business. Among those, of our country, who have been distinguished for public usefulness, we may name Franklin, Rittenhouse, Fulton, Sherman, &c., who were all hard-working men, and who greatly improved their minds, while they daily labored with their hands.

### § 3. *As a Means of Individual Happiness.*

One of our good and great men has said—" If happiness is to be found upon earth, it must certainly be sought in the indulgence of those benign emotions which spring from rural cares and rural labors." " As Cicero," he continues, " sums up all human knowledge in the character of a perfect orator, so we might, with much more propriety, claim every virtue, and embrace every science, where we draw that of an accomplished farmer. He is the legislator of an extensive family ; and not only man, but the brute creation are subject to his laws. He is the magistrate, who expounds and carries these laws into operation. He is the physician, who heals the wounds, and cures the diseases, of his various patients. He is the divine, who studies and enforces the precepts of reason. And he is the grand almoner of the Creator, who is continually dispensing his bounties not only to his fellow-mortals, but to the fowls of the air, and to the beasts of the field."\*

Though there are many ways and devices by which men endeavor to obtain wealth and happiness, there is perhaps no employment in which these are obtained with so much certainty,—few which apparently better fulfil the

\* Chancellor Livingston's Address before the Society of Agriculture and the Arts.

beneficent designs of the Creator—than that assigned to our first parents—the cultivation of the soil. It has, to be sure, like all other avocations, its cares and its toils—its thorns ;—yet its cares and its toils often turn out to be substantial blessings ; and, unlike most other avocations, it has more of the roses than the thorns of life. “ Agriculture,” wrote Socrates, “ is an employment most worthy the application of man, the most ancient, and the most suitable to his nature ; it is the common nurse of all persons, in every age and condition of life ; it is the source of health, strength, plenty, and riches, and of a thousand sober delights and honest pleasures. It is the mistress and school of sobriety, temperance, justice, religion, and, in short, of all the virtues, civil and military.”

§ 4. *As a Means of enabling us to fulfil the Temporal Duties of Life.*

These duties consist, first, in providing honestly for ourselves and families ; secondly, in helping our neighbor ; and, thirdly, in promoting the good of society at large. It is the due performance of these duties that gives worth and dignity to the human character,—that makes the *good* man,—that renders him useful and respected,—and that constitutes the temporal elements of human happiness. Every virtue has its reward, and every vice a punishment, in one form or another, even here, to say nothing of a hereafter. The indolent man, who provides not for himself and his own, but lives upon the labor of others, becomes a dependant upon the sympathies or charities of the world, and is a stranger to the high and manly feelings that flow from conscious independence. He who cares not for the welfare of his neighbor, or seeks not to promote it, is a stranger to the best feelings of humanity—he is a misanthrope in practice, if not in heart. And he who feels not his obligations to society, for the protection and security it affords him, in the enjoyment of life, liberty, and property—and who does not use a portion of his means and his influence, from a high sense of duty, to promote the common weal—to maintain order, law, and a tone of moral health in

society,—is not a good citizen, whatever may be his pretensions to talents or to wealth.

Now, agricultural employment, in the first place, enables us to provide by our industry for all the first wants, and for most of the substantial comforts of life ;—to superintend and assist in the education of our children ; to form their habits, restrain their bad passions and propensities, and to start them in life in a course of industry and usefulness.

In the second place, the condition of the agriculturist enables him to help his neighbor, and promote his welfare, in a variety of ways—by his counsel, by pecuniary aid, and particularly by his example. In the city, individual example is limited in its influence, or lost in the crowd, except in very eminent individuals ; but in the country, it becomes conspicuous to all ; and the good farmer is sure of benefiting those around him, not only by the improvements which he introduces upon his farm, but by his exemplary deportment in life.

In the third place, no one is better fitted than the farmer, to appreciate his high obligations to society,—no one has a stronger interest in performing them. He enjoys the fruits of his labor in peace and quietude, because the laws protect him. He participates in all public improvements, as they tend to enhance the value of his farm and his products. He rejoices in the prosperity of other professions, as they are his customers. He sees constantly around him the works of Creative Wisdom ; he sees that they are all governed by immutable laws—and that he is himself subject to these laws ; and his employments, his reflections, and a conscious sense of duty, impel in him a desire to aid in carrying out the great and beneficent designs of the Lawgiver.

Having considered agriculture in its influence upon the prosperity of nations,—having demonstrated its susceptibility of great improvements, and noticed some of the principles and profits of the new husbandry ; and having endeavored to satisfy our readers, that there is no employment so conducive to health and happiness, by the labor and study which it involves, as this parent art,—we will



next proceed to speak of some of its principles and practices.\*

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## CHAPTER V.

### EARTHS AND SOILS.

EARTHS are the productions of the rocks which are exposed on the surface of the globe, and are as various as the rocks which produce them. They consist mainly of sand, clay, and lime, with, occasionally, an admixture of magnesia, iron, &c. They are considered more or less fitted to become the basis of a good soil, in proportion to the quantity of organic remains which the rocks contain from which they originate—primitive rocks affording the poorest, and secondary rocks the best basis. Hence the utility of geological surveys. But the earths alone, however blended, do not possess fertility.

Soils consist of earths, with more or less of the decomposed organic matters afforded by dead plants and animals,—which latter constitute the true food of plants, as much as hay, grain, roots, and herbage constitute the true food of farm-stock.

Earths are found in the ashes of plants ; and silex is apparent in the epidermis of Indian corn, wheat, oats, and the hollow grasses ; and, although the earths seem

\* “The man who makes agriculture not merely productive, but honorable ; who surrounds his farm with the images of the most attractive happiness ; who dwells in a neat abode, such as a republican might build, and republican simplicity ought to desire ; who, in addition to the song of the robin, can make the music of contentment flow around his calm abode ; can unite it with the intelligence of a citizen who knows his rights, and is determined to defend them ; who shows that *this business* is favorable to mental culture, and as fair a road as any to political eminence ;—such a man does more to encourage the profession, than all other causes combined. He touches the springs of action in their centre, and blesses his country and mankind. He plants the laurel beside the plough, and allures thousands to come, and, after having toiled within its fragrance, to sit beneath its shade.”  
—Whittington’s *Address before the Essex Agricultural Society.*

essential in both the animal and vegetable structure, they are not considered as forming any portion of the *proper food* of either. Lime enters adventitiously into the food of animals, and is transformed into bone. Silix enters in the same way into the food of vegetables, and forms a part of the epidermis of plants, like those we have named, rendering them hard and rigid; and seems designed to strengthen and defend them from the attacks of insects and parasitical plants. The earthy parts of the soil are useful in retaining water, an essential agent in preparing the food of vegetables, and the medium of conveying the food thus prepared into and through the vegetable structure; and they are also useful in producing the proper distribution of animal and vegetable matter. It is the finely-divided matter, principally clay and lime, which gives tenacity and coherence to soils, a strong affinity for moisture and manures, and which most tends to fertility, when it does not exist in excess.

“A certain degree of friability, or looseness of texture, is also required in soils, in order that the operations of culture may be easily conducted; that moisture may have free access to the fibres of the roots; that heat may be readily conveyed to them, and that evaporation may proceed without obstruction. Both water and air must *circulate* in a soil, to render it productive. Hence the presence of sand is necessary. As alumina possesses all the properties of adhesiveness in an eminent degree, and silix those of friability, it is obvious that a mixture of these two earths, in suitable proportions, would furnish every thing wanted to form the most perfect soil, as to water and the operations of culture. In a soil so compounded, water will be presented to the roots by capillary attraction. It will be suspended in it, in the same manner that it is suspended in a sponge, not in a state of aggregation, but minute division, so that every part may be said to be moist, but not wet.”—*Grisenthwaite*.

Another property to be regarded as of value in a soil, is its capacity to absorb moisture from the atmosphere, in which vapors more or less always abound. The soils which possess this property in the highest degree, are

those which contain sand, finely-divided clay and lime, in due proportions, and animal and vegetable matters. If such soils are rendered permeable to the atmosphere, which is always charged with the gaseous food of vegetables, by good tillage, and by the surface being kept clean and loose, they are seldom affected by drought. Carbonate of lime, and animal and vegetable matters, impart to the soil this property, without increasing its tenacity. A soil containing 11 parts of carbonate of lime, and 9 parts of vegetable matter, in 1000, when dried to 2120, gained in an hour, by exposure to air, saturated with moisture, at a temperature of  $62^{\circ}$ , 18 grains; 1000 parts of fine sandy soil gained, under like circumstances, 11 grains; and 1000 parts of coarse sand only 8 grains.\* Thus it would seem, that the power of a soil to absorb moisture from the air, and with air other elements of fertility, depends, first, upon the presence of vegetable and calcareous matters; and, secondly, upon the soil being well tilled, and the surface rendered permeable to the atmosphere.

The color of the soil has an influence upon the agency of heat in inducing fertility, and consequently early maturity of the crop. Several farm-crops, in our northern latitude, require a high temperature in the soil to bring them to timely maturity. Such, particularly, are Indian corn, and, in unfavorable seasons, the potato. White soils, especially of clay, are heated with difficulty, owing not only to color, but to compactness and retentiveness of moisture. Such are truly denominated cold soils. Black soils, abounding in vegetable matter, heat rapidly under the sun's rays, and cool almost as rapidly when the sun's rays are withdrawn. Sir H. Davy found that a rich black mould, which contained nearly one fourth of vegetable matter, had its temperature increased in an hour, from  $65^{\circ}$  to  $88^{\circ}$ , by exposure to sunshine; while a white chalk soil was heated only to  $69^{\circ}$  under the same circumstances.

Now, as the soil supplies all our wants, and is, directly

\* Davy's Agricultural Chemistry.

or indirectly, the source of our wealth and enjoyments, it merits our particular study and attention. The measure of the blessings which it confers on the human family, is wisely made to depend upon the intelligence, skill, and industry which are employed in its cultivation. If these are properly applied, the reward will be bountiful. If they are neglected, want, vice, and wretchedness will ensue.

To render his farm-stock profitable, in meat, milk, and wool, every farmer knows he must provide for them an abundance of wholesome food, as he must be aware that it is this food which makes his meat, milk, and wool, and gives the ultimate profits. And he takes care, if he is a good manager, so to economize his food as to yield him the greatest return in these products. We should think him very improvident, who, instead of feeding out roots and forage to his stock, should throw them away, or let them spoil for want of a little care, or permit them to be consumed by his neighbors' stock.

Let these remarks be applied to our plants. Our farm-crops, like our farm-stock, must be fed, if we would make them profitable to us; and the former, like the latter, will be profitable precisely in proportion to the food we give them, and the judicious care with which we give it. The vegetable lives and thrives upon animal and vegetable matters, after they have become useless to the animal, and are reduced, by decomposition, to a liquid or gaseous state. Every substance that has once belonged to an animal, has previously been a vegetable; and every substance that has been a vegetable, whether it be found in a solid, liquid, or aeriform state, is convertible into living plants. So that it is as important, in good farming, to economize dung, or whatever will make dung, and judiciously to feed it to crops, as it is to husband well the hay and grain of the farm, destined to feed and fatten the cattle. The soil is the stomach, the receptacle of the food of plants, in which manure is digested, converted into substances that are soluble, that is, capable of being dissolved, by the moisture of the soil; and afterwards being absorbed by the minute roots of plants,

—as food, after undergoing the digestive process in the animal stomach, is taken up by the lacteals. In the animal, the food, after undergoing various changes, is converted into flesh, bone, sinew, milk, wool, &c. In the vegetable, the food, in like manner, is converted into stem, foliage, blossoms, and fruit, grain, or roots. Both the animal and the plant exhaust the food which nourishes them; and if we would keep the animal fat, or the soil fertile, we must continue to replenish the food.

We have introduced this comparison here, in order to impress more fully upon the minds of our young readers, the importance and the means of feeding their crops.

Soils are variously classed by different writers. Von Thaer and Fellenburgh have enumerated more than eighty varieties. Sinclair has divided them into sand, gravel, clay, chalk or lime, peat, alluvial, and loam. We shall adopt the latter classification, and consider each separately.

1. *Sandy soils* are those where sand most predominates. They are loose, easily worked, but are not retentive of manure or moisture, owing to their porous texture. They are best adapted to tap-rooted plants, as carrots, turnips, clover, lucerne, to Indian corn, and alternating husbandry. They comprise a great portion of the lands upon the Atlantic border, from New York to the Capes of Florida, and most of the pine lands of the interior. Their mechanical texture is improved by marl, and by an admixture of clay, which often underlay them, or abound in their vicinity. If the silex does not exceed 60 to 65 per cent., they are as profitably managed, under good husbandry, as most other lands. Under the old exhausting system they soon become worthless. If not too flat and wet, sandy soils are well adapted for sheep, which assist much to keep up and to increase their fertility. The county of Norfolk, in England, is principally a sandy soil. Sixty years ago it gave but a very lean product; but under the alternating system of husbandry, including the turnip culture, it has become the most productive and profitable county for agricultural products in England. Flanders is mostly sand, and a portion of it was original-

ly poor and unproductive ; yet there is perhaps not now a district in Europe that makes a better return for agricultural labor. Where sands contain carbonate of lime, and are kept in good condition, they yield wheat, barley, and other farm-crops, besides those first enumerated, and become converted ultimately into a species of light loam.

The celebrated Mr. Duckett, of England, founded his practice in managing sandy soils on three principles : 1. He ploughed very deep ; a due degree of moisture was thus preserved in his light land, by means of which his crops escaped the evils of drought, while his neighbors' crops suffered severely. 2. He ploughed seldom, but effectually covering all the weeds. He sometimes raised seven crops with four ploughings. One good ploughing will always suffice to prepare sandy ground for a crop ; and a second ploughing is injurious, if it turns up the sod or other vegetable matters to the surface. The cultivator will frequently supersede the use of the plough, in the preparation for a crop. It is a good practice to sow clover or grass seeds with all small grains, or broad-cast crops, upon sands, to improve the texture, and to impart fertility to the soil. The benefits will greatly overbalance the expense.

The Flemings have converted some districts, which were originally a barren white sand, into a most fertile loam. They cultivated at first only to the depth of three or four inches ; but gradually went deeper as the soil became enriched, until they had got a very deep soil—and now the ground, says Sinclair, at the commencement of every rotation, is trenched by a shovel (the soil being very loose) to the depth of fifteen to eighteen inches, the exhausted surface is buried, and the fresh surface brought up, enriched by the manure washed down to it during the preceding seven years.

The generic name of a soil is determined by the earth which prevails in it ; as clayey, sandy, calcareous, &c. Where two prevail to all appearance equally, then their names may be conjoined, as clay and sand, lime and clay, &c. The term sandy, according to Davy, should not be applied to a soil which does not contain seven eighths of

sand ; sandy or gravelly soils that effervesce with acids, should be distinguished by the names of calcareous sands, or calcareous gravels, to distinguish them from those that are silicious. The term clayey soil should not be applied to any land that contains less than one sixth of impalpable matter, not considerably effervescing with acids ; the word loam should be limited to soils containing at least one third of impalpable earthy matter, copiously effervescing with acids. A soil, to be considered as peaty, ought at least to contain one half of vegetable matter. In cases where the earthy parts of a soil evidently consist of the decomposed matter of one particular rock, a name derived from the rock may with propriety be applied to it. Thus if a fine red earth be found immediately above decomposing basalt, it may be denominated basaltic soil. If fragments of quartz and mica be found abundant in the materials of the soil, which is often the case, it may be denominated granitic soil ; and the same principles may be applied to other like instances. In general, the soils, the materials of which are the most various and heterogeneous, are those called alluvial, or which have been formed from the depositions of rivers ; and these deposits may be denominated silicious, calcareous, or argillaceous ; and in some cases the term salinic may be added as a specific distinction, applicable, for example, at the embouchure of rivers, where their alluvial remains are overflowed by the sea. Such are some of the rules for classifying soils laid down by Loudon, in his *Encyclopedia of Agriculture*.

We occupy a soil which may be strictly denominated a sandy one. We have dressed some of it with blue clay, containing from twenty-five to thirty per cent. of carbonate of lime, say at the rate of from twenty to thirty loads to an acre, and we are continuing the practice ; being persuaded, from philosophy, as well as experience, that a load of blue clay is ultimately of more benefit to our soil than a load of barn-yard manure.

In the application of clays, or clay marl, and most clays contain a portion of carbonate of lime, "the great point to be obtained," says Professor Emmons, in his *Geologi-*

cal Report, "is to secure a sufficient degree of fineness, that they may be incorporated with the soil, and form, strictly speaking, a constituent part of it. To attain this object, it is necessary that they should be raised in the autumn, and placed in heaps, that they may be exposed to frosts and the atmosphere through the winter. To assist still further in the process of pulverization, it is better to mix them with barn-yard materials, straw, manure, and refuse of any kind, either animal or vegetable. This course being pursued with them, they should be spread as evenly as possible upon green sward, that they may enjoy the further benefits of air, moisture, &c., by direct exposure during the season. Besides, the grass, passing up through the layer, will assist greatly in producing a comminuted state. The succeeding season it is in a state to be ploughed in, when it is duly prepared to become a constituent part of the soil. It is only in this way that the stiff and adhesive clays can be broken up, and prepared for, and incorporated with, the other earths."

Our practice differs somewhat from the preceding recommendation of Professor Emmons. Our leisure time for drawing clay is generally in the winter, and we are enabled to obtain it at this season from the clay-banks in Albany. We do not place it in piles, or mix it with other materials; but scatter it immediately from the wagon upon the sward, as evenly as its adhesive properties will permit. In this way it becomes better exposed to the ameliorating influence of the weather. The frosts and the rains break down the lumps; and when the clay has afterwards become dried, it is readily pulverized with the maul or roller, and distributed by the harrow.

Upon the utility of employing vegetable or animal substances, in conjunction with marl, or other varieties of calcareous manure, Professor Emmons remarks:—

"It must be plain that carbonate of lime, or sulphate of lime, cannot support vegetation without other materials. It appears, however, that a large proportion of the food of plants exists in the earth in an insoluble state; that it is by a chemical union of this calcareous matter and this insoluble vegetable substance, that it becomes soluble,



and fitted for the sustenance of plants in general ; hence arises the mutual benefit of combining earths with vegetable and animal substances ; and hence, too, the bad practice of continuing the mineral manures until the whole of the vegetable and animal matter is withdrawn from the soil ; for by the increased activity of the growing vegetable, the soil is rapidly exhausted of its nutritious matter, and it is left comparatively barren, if the agriculturist ceases to supply vegetable and animal manure. There remains then but one course, that of supplying directly the necessary nutriment ; but it is unquestionably better to maintain a sufficiency of vegetable matter always in the earth, and never suffer a soil to be exhausted or worn out by overtaking its resources.”

We subscribe to the Professor's recommendations, though we do not exactly agree with him in his premises, that all calcareous matters tend to accelerate the exhaustion of organic matters in the soil. We think this remark will only apply to caustic or quick lime. Davy proved that it did not apply to gypsum ; and it is generally conceded, that calcareous soils are less liable to be exhausted than soils that are not calcareous.

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

“Gravelly soils are improved by draining, where they are troubled with springs ;—by deep ploughing ;—by mixing with them coats of clay, chalk, marl, peat, or other

earth ;—by frequent returns of grass crops ;—by repeated applications of manure ;—and by irrigation, if the water be full of sediment, and judiciously applied on a proper form of surface.”—*Code of Agriculture*.

Gravelly soils, like sandy ones, if dry, become soon heated by solar influence, but they retain the heat longer than sands. They are therefore the earliest soils, and are most liable to suffer from the droughts of summer. Hence the crops upon them should be upon a clover or grass ley as often as practicable.

The crops suited to these soils, are Indian corn, turnips, clover, barley, rye, peas, oats, and, if a portion of the ground is calcareous, good crops of wheat may be obtained. When they are cropped with small grains or summer-ripening crops, these crops should be sown very early. The warmth of the soil will admit of it, and the crops may then mature before they are injured by the intense heats of our mid-summers. If gravelly lands are poor, or unfriendly to arable husbandry, they should be left in wood, or planted in wood.

3. *Clay soils* are tenacious, stiff, very retentive of moisture, can only be well worked in favorable seasons, and require extra labor in their tillage. If too dry, the soil breaks up by the plough in hard clods or lumps. If wet, it assumes the appearance of mortar. In either case, pulverization, the main object of ploughing, is not effected. Yet clay soils yield heavy crops, when they are got in in good order. The great expense of tillage, however, and the rich herbage which they afford, induce many farmers to appropriate them mainly to meadow and pasture.

But clay soils vary greatly in texture, according to the quantity of other earths which are commingled in their composition ; and they vary in fertility according to the quantity of vegetable matter which they contain, and the nature of the subsoil upon which they repose : if the latter is retentive, and impervious to water, the soil will be wet, cold, and unfriendly to those crops which require much heat to bring them to maturity. Clay soils are of all intermediate qualities between a dead barren mass and

fine clay loams, which are friendly to most farm-crops, and most profitable to the owner.

Clay soils are adapted to the growth of wheat, timothy, oats, and, if possessing a dry bottom, to clover and potatoes. When intended for a spring crop, it is advantageous to plough in the fall, that the frosts may break down and pulverize the surface, and that the vegetable matters turned under may have the better chance to rot in time to benefit the crops.

There has been recently introduced into Great Britain a new and highly advantageous mode of improving clay lands for tillage, by means of the subsoil plough. Trench ploughing has long been practised, and is analogous, in its effects, to trenching with the spade, as practised in Flemish husbandry. In trench ploughing, a second plough follows in the track of the first, and throws a portion of the subsoil to the surface. In subsoil ploughing, no portion of the subsoil is brought to the surface, but merely loosened, and pulverized, until, by the admission of air and of water, and by their free circulation through it, it becomes so improved as to possess the fertility of the upper stratum, and is then blended with it. Air and water are charged with highly fertilizing properties; yet if either remains long stagnant, it loses its fertilizing properties, and becomes prejudicial to vegetable as well as animal health and growth. Trench ploughing mixes the sub with the surface soil, or rather the latter with the former, before the ameliorating influence of air and water has operated upon it, and therefore trench ploughing often proves prejudicial to the first and second crops. But neither trench ploughing nor subsoil ploughing can develop all its advantages upon a stiff clay, with a horizontal surface, without the auxiliary aid of what is termed furrow-draining, and of which we shall speak more particularly in our chapter upon draining. The effect of subsoil ploughing *then*, is, to free the soil at all times of an excess of water, to fit it for cultivation, at a much earlier period in the spring, and to increase its fertility.

The advantages of subsoil ploughing have been particularly illustrated by Robert Laing, Jr., in the Edinburgh

Quarterly Journal of Agriculture, who had practised it two years. The plough operated to the depth of twelve to fifteen inches, and was worked by a three and four-horse team. "The field in which the operations were commenced," says Mr. Laing, [in 1836,] "consisting of ten Scottish acres, was at the time, and during the whole operation, so saturated with rain, that the horses' feet sunk in the unploughed ground from four to six inches. Notwithstanding the disadvantages consequent upon the wet state of the field, the results have been of the most flattering description. Since the work has been finished, [the communication being written two years afterwards,] little or no water has stood upon the surface, and in the spring of 1837, this field, which was usually last workable upon the farm, from its wetness, was the first; and it had the advantage of land working like loam, when compared with the solid soured furrow that was wont to be turned up." The land thus managed produced in 1837, the season after it was subsoil ploughed, 48 bushels of beans the Scottish acre, at least one quarter more than it would have yielded had the field not been subsoil ploughed, and in 1838, it produced 48 bushels the Scottish acre. The opinions of Mr. Laing, of the great advantages of subsoil ploughing, are amply sustained by the experience of many farmers, whose communications have appeared in the foreign agricultural periodicals. The subsoil plough should, however, be preceded by furrow-draining.

4. *Chalk soils*, or those containing an excess of calcareous earth, do not much abound with us. Lime is deemed essential in a wheat soil; and if it amounts to two per cent. of the tillable surface, it is considered adequate to the wants of this crop. Soils derived from primitive formations seldom contain much if any of this earth, and hence the difficulty of raising wheat upon them. If combined with clay and other earthy and vegetable matters, these soils are very productive; if with sand or gravel, they are light and often unfertile. Calcareous earth has a strong affinity for putrescent vegetable and animal matters, and increases the absorbent power of soils to which

it is applied. It corrects the adhesive qualities of clays, and augments the absorbent and retentive qualities of sands. Hence the advantage of applying lime to clayey, and clay-marl to sandy lands.

The means of ameliorating, or rendering productive, a soil too calcareous, are, to mix with it sand or clay loams, or pure clay; or, where the vegetable matter is deficient, to blend with it quantities of peat or swamp earth, or yard dung.

Tillage crops are best adapted to calcareous soils, as peas, turnips, barley, clover, wheat, and Indian corn. It is difficult to bring these soils into permanent pasture or meadow.

5. *Peaty soils*, are those of our swamps and marshes, in which vegetable matter exists in excess, in consequence of their being habitually saturated with water, which has prevented its decomposition. On being thoroughly drained, some of these soils, in which the vegetable has been reduced to something like soft, black powder, or where the earths constitute a considerable portion of the surface stratum, have become very productive. But where the vegetable matters greatly preponderate, or are coarse and woody, it has been found necessary, in order to render them valuable, after draining, to bring on a decomposition by paring and burning the surface, or by the application of lime, or barn-yard manure; and sometimes a good dressing of sand, or loam, has induced fertility. The cause of sterility is not the want of vegetable food, but the want of this food in a soluble or cooked state, prepared for the mouths and the nourishment of plants.

An author who has successfully explained the nature of peat, says Sinclair, has adopted the following classification: 1. Fibrous; 2. Compact; 3. Bituminous; 4. Peat mixed with calcareous matter; 5. with sand or clay; 6. with pyrites; 7. with marine salt. These, he contends, differ essentially in their composition and chemical qualities; and, above all, each species requires a different treatment, in order to convert it either into a soil or into a manure.

The crops best calculated for reclaimed swamps, or

peaty grounds, are oats, potatoes, rye, turnips, carrots, and Indian corn ; clover, timothy, red-top, and other grasses. When properly drained and subdued, hay crops make good returns on peaty lands. By suffering the second crop of grass to rot upon the ground, instead of feeding it off as is usual, the Flemings have experienced an immense increase of hay the ensuing year, and in this way their fenny grounds are converted into permanent meadow. The application of gypsum would, no doubt, with us, in the interior, tend further to increase the crop, and perpetuate fertility.

If the surface consist of bogs and other living vegetable matters, roots, &c., it must either be burnt or carried off. The ashes are useful if spread upon the surface, and they may also be applied to uplands with great advantage. Peat earth may be also extensively and profitably used for uplands, after it has laid for a season in the cattle or hog-yard, and been subjected to the tread, and become mingled with the urine and other excrementitious matters of the yard ; or after it has been mingled in compost with lime, ashes, or unfermented stable manure, till the process of decomposition or fermentation has commenced.

6. *Alluvial soils* are, first, those which have been formed by the action of the sea, which are composed principally of sand, with but little of organic matter except marine shells, such as the great level sandy districts lying along the border of the Atlantic ; and, second, those which have been formed from the deposits of rivers, as upon the Mississippi, Ohio, and upon most of the secondary and minor streams of our country. The composition of the latter depends upon the geological formation of the country from which the deposits are brought ; and the degree of fertility somewhat upon the force of the current by which they have been deposited,—the coarser matters only being left where the stream is rapid, and the finer and richer materials, being specifically lighter, subsiding only where the waters become tranquil. Hence alluvial soils are various in their character and productiveness. Those of the first class are generally

sandy, except where the formation is aided by fresh-water streams, in which case clay is found extensively mixed with sand, as also marine shells and vegetable matters. Of the latter class of alluvial soils, those created by rivers, the earthy elements are more generally blended with a greater admixture of organic matters. Where the deposit has been made by a rapid current, gravel or small stones will predominate, and the soil will be comparatively poor. As the force of the stream abates, sand will next subside, while the finer earthy and enriching matters will be found deposited upon the borders of still waters.

Where alluvial grounds are subject to frequent, or to annual inundation, and the character of the soil will permit, they should be appropriated to permanent grass. If tilled, the soil is liable to be worn away or injured, and the crops destroyed, by freshets; while, if in grass, the deposits made by the waters will tend to keep up fertility. If not subject to floods, they may be cropped, as uplands of the same character are cropped.

7. *Loams*.—"Where a soil is moderately cohesive, less tenacious than clay, and more so than sand, it is known by the name of *loam*. From its frequency, there is reason to suppose, that, in some cases, it might be called unoriginal soil. At the same time, a constant course of tillage for ages, the application of fertilizing manures, where necessary, (as clay with sand, or sand where clay predominates) will necessarily convert a soil thus treated into a loam.

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

“Loams are of four sorts : 1. Sandy ; 2. Gravelly ; 3. Clayey ; and, 4. Peaty.

“1. A sandy soil and a sandy loam, are easily distinguished. A sandy soil is always loose and crumbling, and never gets into a clod, even in the driest weather ; whereas a sandy loam, owing to the clay which is mixed with it, retains a degree of adhesion or cloddiness, after wetness or drought, and will not suddenly crumble down, without the application of machinery for that purpose.

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

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

“3. A clayey or stiff loam, is nearly allied to brick earth. Though the soil might originally have been poor, cold, and hungry, yet, if it be well drained and highly manured, it will yield great crops. It is found well adapted for the dairy.

“4. Peat, in some of its varieties, may likewise be converted by culture into a species of black, soft loam, and, in that state, it becomes highly fertile and productive.”—*Sinclair's Code of Agriculture*.

It has been already mentioned, that mould containing a mixture of animal and vegetable remains, is an essential ingredient in all fertile soils ; that the effect of cropping is to diminish this fertilizing property ; and that if vegetable and animal matters are not returned, to make up for the exhausting influence of the crops taken off, the soil will ultimately become sterile and barren.

The offices of the soil are, 1. To receive and digest the food designed for the growing plant. 2. To serve as a medium for conveying to the spongioles or mouths of plants, the water holding in solution the different substances which pass into and nourish them. And, 3,



to serve as a basis for fixing the roots of plants, and maintaining them in an upright position.

The agents in vegetable nutrition, or growth, are air, heat, and moisture. The seed cannot germinate and grow, nor the food be prepared nor transmitted to the plant, without the united co-operation of these agents. Hence the utility of draining, ploughing, pulverizing, &c., to render the soil permeable to solar and atmospheric influence. But of these matters we shall speak more fully in another place.

### *Subsoil.*

“The value of a soil depends much upon the nature of the subsoil or under stratum. On various accounts its properties merit peculiar attention. By examining the subsoil, information may be obtained regarding the soil itself; for the materials of the latter, are often similar to those which enter largely into the composition of the former, though the substances in the soil are necessarily altered, by various mixtures, in the course of cultivation. The subsoil may be of use to the soil, by supplying its deficiencies, and correcting its defects. The hazard and expense of cultivating the surface, are often considerably augmented by defects in the under stratum, but which, in some cases, may be remedied.

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

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

“A retentive, clayey, or *tilly* subsoil, is highly injurious. The land is soaked with water, is ploughed with difficulty, and is not in a condition to exert its powers, until the cold, sluggish moisture of the winter be exhaled. By the water being retained in the upper soil, the putrefactive process is of course interrupted, and manures are prevented from operating. The plants likewise, from the roots being chilled, can make but little progress. Hence, when grain is cultivated, it is always of inferior quality, and the herbage, when in grass, is coarse.

“A clayey subsoil, however, may sometimes be of material advantage to a sandy soil, by retaining moisture,

in such a manner as to supply what is lost by evaporation, and the consumption of plants.

“When soils are immediately situated upon a bed of impervious rock or stone, they are much sooner rendered dry by evaporation, than where the subsoil is clay or marl. A stony subsoil, when in a position approaching to the horizontal, is, in general, prejudicial, and, if the surface soil be thin, usually occasions barrenness; unless the rock should be limestone, and then the soil, though thin, is distinguished for its fertility.

“2. A porous subsoil, if not carried to an extreme, is uniformly of great advantage, not only by its admitting the fibrous roots of vegetables to extend deeper, in search of moisture and nutriment, but also from its carrying off all superfluous moisture, which is less perfectly done artificially, by the expensive operation of hollow-draining.

“Below clay and all the variety of loams, an open subsoil is particularly desirable. It is favorable to all the operations of husbandry;—it tends to correct the imperfections of too great a degree of absorbent power in the soil above;—it promotes the beneficial effects of manures;—it contributes to the preservation and growth of the seeds;—and insures the future prosperity of the plants. Hence it is, that a thinner soil with a favorable subsoil, will produce better crops than a more fertile one, incumbent on wet clay, or cold or nonabsorbent rock.

“Lands whose substratum consists of clean gravel or other silicious earths, can bear but little sun, owing to their not having a capacity of retaining moisture, and their generally possessing but only a shallow surface of vegetable mould.”—*Sinclair's Code of Agriculture.*

The difficulties resulting from a retentive subsoil are likely to be obviated, in a great measure, by improvements of recent introduction;—viz., furrow-draining, and subsoil ploughing. The first drains off the surplus water from the surface soil, and the latter deepens the soil, and facilitates the passing off of surplus water.

## CHAPTER VI.

## IMPROVEMENT OF THE SOIL.—PRELIMINARY OPERATIONS.

IF we put into the hands of the manufacturer a sack of wool, a bale of cotton, or a bundle of flax, it is always understood, that these materials, eminently calculated as they are to administer to our wants and our comforts, must necessarily be wrought by the manufacturer into fabrics, and thence be transferred to the tailor, to be converted into wearing apparel, before they can be useful for the great purposes for which they are so admirably fitted—to protect and embellish the human form. When we pass our meats and our vegetables into the hands of our wives, daughters, or domestics in the kitchen, it is well understood by every one, that before they are fitted for the primary purposes of life—for our nourishment and the gratification of the palate—they must undergo the culinary processes of cooking. And when we are presented with a goodly soil, prolific in all the substantial blessings of life—the primary source of our food and clothing—we are admonished by every thing around us, that if we would enjoy these blessings, in all their purity and richness, we must, like the manufacturer, the tailor, and the cook, exert those powers and faculties which God has given us for this purpose, in rendering this soil what it was designed to be, a fountain of temporal blessings. The manufacturer, the tailor, and the cook may abuse their trusts, and, from ignorance or indolence, spoil or waste what it is their interest and their duty to improve; and the husbandman may, by a reckless course, pervert the high trust confided to his care, in the management of the soil. They have each their assigned duties. The means of usefulness are before them. They are endowed with capacities for manufacturing the cloth, making up the garment, cooking the food, and rendering and keeping the soil fertile;—and their reward, certainly in temporal

blessings, will very much depend upon the honesty, intelligence, and fidelity with which they acquit themselves in their several duties. Every person should consider that he comes into the world for some purpose of usefulness ;—that nothing has been made in vain ;—that he ought at least to provide for himself and his own ; and that he fulfils the high duties of life in proportion as he contributes, by his means, his example, and his influence, to improve the condition of society at large. And as his capacities for improving the soil will depend very much upon the developement of the powers of his mind, the culture and improvement of the mind should receive the early and constant care of the husbandman.

The natural elements and agents of fertility in the soil, are organic matters, which constitute the food of farm-crops, and heat, air, and moisture, which are essential in the preparation of this food, and to its conversion into grain, grass, roots, &c. The first of these is constantly accumulating upon the surface, by the death and decay of animals and vegetables ; the sun gives the second, the atmosphere gives the third, and the clouds the fourth. Without the aid of heat, air, moisture, and manure, labor and art can do little to render the soil productive ;—with them, skill and industry need never exert their powers in vain. It is the province of the husbandman to understand the laws by which these agents are rendered most subservient to his use ; and to assist, and in some sort to regulate, their influence upon the soil and upon vegetable growth. This he does by clearing and cultivation,—by rendering the soil permeable to heat and air, and to the roots of plants,—by regulating, as far as practicable, the supply of moisture, and by furnishing to the soil the elements of vegetable food as these become exhausted by cultivation.

The clearing of land for the purposes of husbandry, is too well understood, when it is required to be practised, to need illustration here. It consists in cutting down, burning, or carrying off the timber, brush, and other matters which obstruct the plough, and in baring and opening the soil to the ameliorating influence of the sun and

the atmosphere. Burning the vegetable matter upon the surface of new lands, tends to accelerate their fitness for producing good crops. It converts much woody or insoluble, into soluble matter; corrects the natural acidity of the soil, and imparts to it much of the benefit which results from ploughing and longer exposure. A *good burn* is a pretty certain indication that a good crop will follow; and a *bad burn* is almost as certain a precursor of a bad crop. Hence, in clearing up new lands, the timber is generally felled, when the foliage is most abundant, in June or July; the fallow is burnt when the fire is likely to operate most efficiently, both in destroying the vegetable matter upon the surface, and in ameliorating the soil, say in August or early in September, and the first crop is put in with the harrow or drag soon after.

We cannot but remark here, that in our zeal to *clear up*, we generally carry the matter to an unwarrantable extreme; every thing is cut away—the whole surface is denuded—stripped of its natural growth. We know that old forest-trees will not long bear an open exposure—that the winds will prostrate them when deprived of the protection of surrounding forests; yet the young growth, if left in clumps and belts upon the bleak borders, the division lines, about the farm-buildings, or upon portions of the farm not adapted to ploughland or to meadow, would tend ultimately to enhance its value, by the beauty which they would impart to the landscape, the shelter and protection which they would give to crops and cattle, and by the resources which they would give for fuel, fencing, and timber. The settler upon new lands may *preserve*, without labor or expense, that which it would cost much time and money to *produce*—that which imparts to old-settled districts the highest rural charms, and gives to them much of their intrinsic value. To destroy, in this case, is but the labor of a day; to restore, is the work of an age.

After the timber has been removed from forest lands, and the first crop put in, the stumps will remain for some years, to obstruct, partially, the further operations of improvement. The plough cannot yet do its office

thoroughly ; and neither draining nor freeing the surface from stones, where these are in the way, can be managed with economy, if the new settler has the time and the means of doing them. The most approved practice, therefore, is, to sow grass-seeds with the first crop, where the land can be spared for this purpose, and to leave the field in grass, till the stumps, or the greatest portion of them, can be readily drawn out with a team, or turned out with the plough. When this can be done, the other operations of improvement,—removing the surface stones into walls, draining, manuring, thorough tillage, and alternation of crops, are more or less necessary, to induce and keep up fertility. But these seldom engage the attention of the pioneer in improvement. He considers that he has done his part ; or, rather, he does not seem conscious that he is capable of going further. He generally goes on cropping, without giving manure to his soil, and without seeming to know, that the soil is every day becoming less and less capable of supplying his wants. The ulterior improvements must be generally undertaken by his children or successors, or not undertaken at all. Hence the deterioration which has been going on in a great portion of our lands from the time of their first settlement. And hence the inducement of countless multitudes to emigrate to the west, where the natural fertility of the soil has not yet been exhausted by a reckless system of husbandry.

The natural quality and condition of soils have not so much influence upon their ultimate products and profits, as the good or bad management which they receive. Some of the now poor lands in the Atlantic States, were once as rich and productive as the now rich lands of the Ohio and Mississippi valleys ; and the latter, under the treatment which the former have received, will as certainly become poor, as that like causes will produce like effects. Nature was as bountiful to the east as she was to the west ; and gave to us the same means and capacities for improving and enjoying her bounties, as she has given to them ; but we have abused her gifts—we have disregarded her admonitions—and we are suffering the penalty of our disobedience in an empoverished soil. Nor

can the west expect to escape a similar calamity, if she is alike unmindful of her duty and her interest.

But, though late, we are beginning to see our errors, and to atone for them, by adopting a better system of farming,—by improving the bounties of Providence. We are renovating some of our worn-out lands ; and begin to find, that, under a better management, we can not only restore them to primitive fertility, but greatly increase their productive properties. We have begun to call into exercise those faculties, long dormant, which have profited the manufacturer and the artisan, and to study, and to apply to husbandry, those natural laws—that science—which must ever govern its operations, wherever its labors are wisely applied. Instead of getting a bare reward for labor, with a diminution of fertility, as in former times, we are augmenting the capacities of the soil, and doubling, trebling, and quadrupling its products. We are now demonstrating, that agricultural pursuits are not only the most healthy and useful, but that, judiciously managed, they are a means of wealth, and of independence and happiness, which few other employments in life confer.

To point out some of the prominent features of this better system of husbandry—whereby the fertility of the soil is progressively improved, the labors of the husbandman better rewarded, and the country at large more benefited, than under the system pursued by our fathers, will be the subject of subsequent essays.

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## CHAPTER VII.

### ANALOGY BETWEEN ANIMAL AND VEGETABLE NUTRITION.

It may not be inappropriate here, with a view of bringing the process of vegetable nutrition and growth more directly home to the understanding of the unlearned reader, to notice some of the analogies which exist between the animal and vegetable kingdoms.

Animal and vegetable matters constitute the food alike

of animals and vegetables ; yet these matters nourish neither the animal nor the vegetable, until they have undergone certain preparatory processes, and are reduced to a soluble state. Solid substances, so long as they remain solid, can benefit neither the animal nor the vegetable.

The stomach is the place where these preparatory processes are performed for the animal—the soil is the place where they are carried on for the vegetable ;—where the food undergoes the first process of decomposition, is broken down and rendered solvent, by the gastric juices of the stomach, and the moisture and constituents of the soil.

After this process is completed, the nutrient matter of the animal food is taken up by the lacteals of the animal, and sent to the lungs, for its final preparation to become flesh, bone, &c.—and the nutrient matter of the vegetable is taken up by the spongioles, or the extreme points of the minute root-fibres, and sent to the leaves for final elaboration, fitted to nourish and enlarge all parts of the vegetable system, and to become grain, grass, roots, &c.

Leaves are to plants, what lungs are to animals,—the organs of respiration.

The air which is inhaled by the animal in breathing, undergoes a material change ; a portion of its oxygen is imparted to the blood, with which it comes in contact in the lungs, and a portion of the carbon is given off by the blood in exchange. By this operation the blood is fitted to become living animal matter. The leaves, in like manner, are the organs of final elaboration to the vegetable blood, or sap. In these, the sap is exposed to atmospheric influence ; and it parts with oxygen, and retains and imbibes carbon, the principal element in vegetable structure, and is thus fitted to become living vegetable matter.

The animal cannot grow, nor long continue to live, without the aid of the lungs. The vegetable cannot grow without the aid of the leaves, nor continue to live if wholly divested of them during the season of growth.

Heat, air, and moisture are essential in all the processes



of nutrition, vegetable as well as animal—in the stomach and in the soil—in the lungs and in the leaves.

The ordinary temperature of the animal stomach is about  $98^{\circ}$ —air is always inhaled by the lungs, and moisture is ever present. Hence the digestive process of animals is seldom arrested from the want of these agents. The decomposition of vegetable food, in the soil, ceases when the thermometer falls below  $40^{\circ}$ , and is most active at the temperature of  $80^{\circ}$ . Hence vegetable nutrition does not go on in the winter, in the absence of heat, and when most plants are shorn of their elaborating organs.

Neither lungs nor leaves can perform their office healthfully, without access to fresh air; nor can decomposition nor germination take place without air.

Water is a necessary solvent in the preparation of animal and vegetable food, for the delicate mouths of the lacteals and spongioles, and is no less indispensable as a medium for transmitting the food to the lungs and leaves, and from thence through the animal and vegetable structures.

After the blood of the animal has been perfected in the lungs, it is conducted, by minute arteries, to every part of the body, and is transmuted, or converted, into flesh, &c. After the sap has become elaborated or changed in the leaves, it is conveyed, in like manner, to every part of the vegetable system, and is transmuted, or transformed, into wood, fruit, roots, &c.

Vegetables, like animals, may be injured by an excess of food; and when food is too concentrated, or too rich, the lacteals and the spongioles become clogged, and unfitted to take up and transmit aliment to the lungs and leaves.

A seed may be compared to an egg. One contains the germ of a chick, the other the germ of a plant. Nature has provided in their envelopes the food proper for both, in infancy, and until both are set free from their envelopes, and can provide for themselves. Through the agency of heat and air, the chick becomes animated, grows, and bursts its shell, and the seed germinates and grows, and bursts its case—its roots strike into the soil, and its stem ascends above it—the roots collect food,

and the leaves convert it into vegetable blood. In the processes of germination and of incubation, light must be excluded.

The elementary matters found in animals and vegetables are rarely the same—the animal contains the most nitrogen, the vegetable the most carbon. Lime and iron are found in both.

In the vegetable, as in the animal, the power exists of throwing off, through their excretory organs, matters, blended with their food, not fitted to their wants, or not assimilating with the elements of their structure. Plants often exhale, or give off, like some animals, a strong odor.

Thus it will be seen, that plants, like animals, are organized beings, fed and fattened, like animals, upon vegetable and animal—upon organic matters; and that the same care, industry, and intelligence are required, at the hands of the farmer, to grow good crops, that are required, in him, to make good mutton or good pork. The importance of providing well for the vegetable is greater than that of providing for the animal; for, while the animal has locomotive power, and can go abroad for food—the vegetable is stationary, and can only send abroad its roots for food—and where this is deficient it must be supplied by art. Besides, to feed the vegetable well, is the true way of providing economically for the animal. For if the crops are good, the means of rendering the animal good are always at command. The animal manufactures the crops into meat, milk, and manure—virtually into money. But if the crops are bad or deficient, an outlay must be made for cattle-food, which will reduce, if not eat up, the profits, or the farmer will be correspondingly deficient in the raw material which he should turn into money. These considerations cannot fail of impressing upon the mind of the farmer the importance of keeping up and of increasing, by all prudent means, the fertility of his soil.

In the management of cattle, no decent farmer would think of *fattening* a score of animals upon the food that would barely serve to keep them in a lean condition. If

he wanted to make money, and to realize a profit from his beef, his policy would be, to sell off half his lean stock, and to fatten his other half upon his supply of food—for what would *keep* a score, would *fatten* half that number. In this way he would evidently be a gainer. He would save the labor of feeding the animals, and have converted into marketable meat the food which they would have required to keep them lean, and which then, in a measure, would have been lost. We go upon this hypothesis,—if an animal requires 20 lbs. of forage to supply daily exhaustion, it cannot increase in flesh upon this bare supply; but if the animal can digest 40 lbs. of food per day, or double what is necessary to supply absolute want, all the additional 20 lbs., or most of it, goes to the increase of meat, milk, &c. Now let us apply these remarks to crops. A farmer cultivates 20 acres of corn, spreading upon each acre five loads of manure. If he gets 30 bushels an acre, he thinks he does well. His labor upon each acre is worth \$15—or on the whole 20 acres it is worth \$300—and he gets 600 bushels of corn, which, at 50 cents per bushel, just remunerates him for his labor. His crop, like the lean animal, is but so so. He gets stalks, but comparatively little corn. Now suppose the food that is given to the 20 acres, sufficient just to keep in it the breath of life, if this figurative expression is admissible, is all applied to five acres, which may be termed stall-feeding—let us see what would be the result. We maintain, and our experience for years will warrant us in the declaration, that the average product, under this system of stall-feeding corn, may be safely stated at 80 bushels the acre. Thus the product of five acres would be 400 bushels, and the expense of culture, at \$15 per acre, \$75—showing a profit of one hundred and twenty-five dollars, or twenty-five dollars an acre. Thus five acres, well fed, would be worth \$125 per annum more than 20 acres badly fed.

The comparisons we have made will be sufficient to justify us in suggesting, as rules in farming—

1. *Not to work more land than can be well worked and well fed ; and,*

2. *Not to keep more cattle than the crops of the farm will feed and fatten, and than may be made profitable to the owner.*

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## CHAPTER VIII.

### FURTHER IMPROVEMENT OF THE SOIL.

WE have seen, in the preceding chapters, what must be apparent to every intelligent observer, that the improvement of the soil by the first settlers, has generally terminated in clearing up the land, and in rendering it subservient to their personal and immediate wants ; and that the further progress in its cultivation, has been rather to wear it out, and exhaust its fertility, without attempting to husband, or even to develop all its resources of wealth. We have said, that under a better, a more modern system of husbandry, a considerable portion of our lands, hitherto unproductive, may be rendered of great value ; that the fertility of the soil may be kept up in lands already subjected to culture—and, where they have been impoverished by severe cropping, that they may be renovated, and may be made to produce as much and more than ever. This better, or more modern system of husbandry, of which we speak, is new only comparatively, and the term new is used in contradistinction to the old system, which is generally adopted in the first settlement of a country, in some degree as a matter of necessity ; but which, being once established, has been too often persisted in till it has impoverished most of the old-settled districts upon our Atlantic border, and is already causing indications of premature exhaustion and poverty in some districts of the west. This deterioration particularly happens in countries like our own, where new and virgin soils are constantly inviting to emigration. What we denominate the new system of husbandry has long been in operation in the valley of the Po, in Italy, and in Flanders ; for the last half century it has been gaining strength in Great

Britain, and is at present carried to a higher degree of perfection in Scotland, probably, than in any other part of Europe. It has, moreover, for some time, been making its way into the United States, where its followers are daily and rapidly increasing. Wherever it has long been in operation among us, it has greatly increased the products of the soil, and the value of the land ; and yet in no district do we believe that half its advantages have been developed.

In the details of practice under the new system, much will depend upon climate, soil, and upon the distance and demands of the market. Where the market is remote, the coarser products must be concentrated in meat, wool, butter, cheese, and other articles, of the least expensive transportation. Near navigable waters, and in the vicinity of large towns, hay, roots, fruit, and coarse grains, may be more profitably cultivated. The products of the soil, as well as the demand for them, must also vary with latitude. Grain, pulse, roots, grass, and domestic animals, are the staples of our northern districts ; rice, cotton, and tobacco constitute the principal products of the southern part of our Union ; while the torrid zone produces coffee, sugar, molasses, &c. Though there are no definite rules of practice that will apply to all zones, or all soils, there are general principles, and essential requisites, which have a general application. In all situations, organic matters constitute the food of plants ; in all situations, heat, air, and water are the essential agents to prepare and convey this food to the mouths of plants, to circulate the vegetable blood, to assimilate it with vegetable structure ; and in all cases are capital, skill, and industry advantageously employed in aiding, and in some measure controlling, the operation of these natural elements and agents of vegetable nutrition and growth.

The modern improvements in husbandry, consist principally, —

1. In manuring ;
2. In draining ;
3. In good tillage ;
4. In alternating crops ;

5. In root culture ; and,

6. In substituting fallow crops for naked fallows.

Most of these are necessary to good farming, in a far greater degree than they have been hitherto considered. They are the distinguishing features of the new husbandry ; and as they are practised with more or less intelligence and fidelity, in that proportion are they likely to advance the interests of the farmer, and to profit the country.

We intend to bestow some notice upon each of these branches of improvement ; and shall endeavor to explain, as we go along, their operation upon the soil, separately and conjointly. In the remarks we shall offer, it will be our object rather to explain the principles upon which the new system is conducted, and which have a common application, and to demonstrate their beneficial influence in husbandry generally, than to detail the minutiae of practice, which must, in some degree, be influenced and controlled by a variety of circumstances.

If we overstock the farm, that is, attempt to keep twice as many cattle upon it, as our pasture and hay will support in a thriving condition—every one will tell us that we don't work it right ; that our cattle, instead of being a profit, under such management, will turn out to be a loss ; that we expend our labor and our forage, without improving their condition, or obtaining any corresponding return. Such is precisely the case with our crops. If we but half feed them, they will be meager, and but illy repay us for their culture: Although, as we have observed, every one can see the folly of half starving cattle, few seem to perceive the folly of half starving crops,—or, if they see, they do not seem inclined to profit from their knowledge. There is many a farmer, who, under the old system, is scrupulously economical of his cattle-feed, knowing that food makes meat, milk, &c., but who is perfectly reckless of his manure, the food of his crops ; apparently forgetting, that crops are to constitute his cattle-food, and that they will be abundant and nutritious precisely in proportion to the food he gives them, and the care which he bestows in their culture. The farmer upon

new-settled lands, acts very much like the prodigal son of wealth, who finds a treasure in his hands, and who, without inquiring how it came there, or how it should be preserved, exhausts it recklessly, without regard to duty or ultimate benefit. So the farmer, under the old system, seems to have regarded the treasures of the soil as a patrimonial inheritance, conferred by Providence, for his especial benefit, and to have gone on and wasted it, regardless of the interests of society and of his offspring. The consequence has been, that he who has wasted the treasures of the soil, like the spendthrift, has often thereby consigned his children to poverty and to want, or driven them to other employments, by the influence of his bad example.

The first requisite, therefore, for improving the fertility of the soil, is to provide plenty of food for the crops which it is destined to nourish. The meal-chest must be occasionally replenished, or it will not long serve to supply the wants of the family. The kine must have daily her forage, or her grain, or she will withhold her accustomed tribute of milk. The field which yields an annual contribution to the husbandman, will become sterile, if nothing is returned to replace the vegetable matters continually carried off. Philosophers have speculated for ages, as to *what constitutes the food of plants*. Without recapitulating the various theories which have had their day, upon this point, every farmer can readily respond to the question, from personal knowledge—that it is MANURE—vegetable and animal matters—which constitute the true food of farm-crops. Mineral, fossil, and earthy substances may meliorate the soil, and increase its capacities for the healthy developement and maturity of plants, or may impart wholesome stimuli to their organs; but vegetable and animal substances, after all, constitute mainly the food of plants. Crops are always good, on well-prepared ground, where these, in a soluble state, are known to abound; and they are always defective, or prove a failure, where these are wanting. Farmers should hence regard manure as a part of their capital—as money—which requires but to be properly employed,

to return them compound interest. They should husband it as they would their cents, or shillings, which they mean to increase to dollars. They should economize every animal and vegetable substance upon the farm, and when it has subserved other useful purposes, apply it, by mixing it properly with the soil, to the increase of the coming harvest—put it to interest, that it may return the owner its per centage of profit, in grain, roots, and forage, and ultimately in the increase of meat, and in the products of the fleece and the dairy. Every load of manure, well applied to the farm, will increase its products to the value of one dollar. The farmer, therefore, who wastes a load of manure, is as reckless and improvident, as he who throws away a bushel of corn. Not only what is denominated dung, as the contents of the cattle and hog yards, and the clearings of the stable,—the amount of which may be greatly increased, by stalks, weeds, vines, and other vegetable matters,—may be transformed into farm produce—but the rich earth of swamps, ditches, and ponds, the leaves of the forest, urine, soap-suds, &c., are all convertible to a like use. He that will not feed his crops with manure, should not complain if his crops fail to feed him with bread.

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## CHAPTER IX.

### IMPROVEMENT OF THE SOIL BY ANIMAL AND VEGETABLE MANURES.

THE great sources of fertility to the farm, are the refuse of the crops which they bear, modified by the farm-stock, and preserved and judiciously applied by the husbandman. There is not a vegetable matter grown upon the farm, be it considered ever so useless or noxious, but will, after it has served ordinary useful purposes, impart fertility to the soil, and contribute to the growth of a new generation of plants, if it is judiciously husbanded and applied. There is not an animal substance, be it



solid, liquid, or gaseous,—be it bone, horn, urine, hair, wool, or flesh, or the gases which are generated by the decomposition of these matters,—but, with like care and skill, may be converted into new vegetable, and afterwards into new animal matters. To economize and apply all these fertilizing materials is the province and the duty of the husbandman. To aid him in this useful labor, is the object of this essay. And,

1st. *Of the cattle-yard.* This should be located on the south side of and adjoining the barn. Sheds, substantial walls, or close board-fences, should be erected at least on the east and west sides, to shelter the cattle from cold winds and storms—the size and the divisions to be adapted to the stock which it is intended to feed. Excavate the centre, or some other part of the yard, placing the earth removed upon the borders, which may be ten to fourteen feet broad, or upon the lower sides, where there is a descent, so that the liquids will all run to the centre, and the borders, which should be left gently inclining, will remain dry and firm, for feeding the cattle upon. The centre may be from two to five feet lower than the borders. The labor may be done principally with the plough and scraper, and smoothed off with the shovel and hoe. We were employed two days and a half, with two hands and a team, in giving a cattle-yard the desired shape. When the soil of the yard is not sufficiently compact to hold water, or is not likely to become so by the tread of the cattle, or the puddling effects of the manure, the bottom should be bedded with six or eight inches of clay, well beat down, and well covered with gravel. This is seldom however necessary. Our yards are upon a sand loam, and yet the liquids never sink into the earth.

When the yard is prepared, the first thing done should be to overlay the whole bottom with six to twelve inches of peat or swamp earth, where it is at command ; and where it is not, with earth from ditches, the road-side, or other rich deposits. It is then fit for the reception of the cattle, and of straw, coarse hay, corn-stalks, and other litter of the farm ; and subsequently, as they may be gathered, the weeds, potato and pumpkin vines, and

other vegetable matters. These materials will absorb or take up the urine and other liquids, and, becoming incorporated with the dung, double or treble the ordinary quantity of manure. During the continuance of frost, the excavation gives no inconvenience ; and when the weather is soft, the borders afford space for feeding the cattle, and for a dry passage to the barn. In this way the urine is saved, and the waste incident to rains, &c. prevented. The barns and sheds which adjoin the yards, should be provided with eve-gutters, which should discharge outside of the yard, so that the waters from the roofs may pass off.

As a further precaution against waste by rains, a cistern or tank may be sunk near the yard, into which an under drain may be made to conduct the liquids, when they are likely to accumulate to excess. These liquids may be pumped into casks upon carts, and employed to great advantage upon grass or arable crops. The Flemings call these liquids the *cooked* food of their crops.

To guard against the wasting influence of the sun in summer, a roughly constructed covering, supported by posts, may be erected over the central depot. This is seldom necessary under our mode of management, which requires a thorough cleaning of the yard every spring, for the corn, potato, and other root crops.

The cattle should be kept constantly yarded in winter, except when let out to water, not only because, if suffered to run at large, they poach and injure the fields and meadows, but because they waste their dung ; and the yard should be frequently replenished with fresh litter. Upon this plan, from ten to twelve loads of manure may readily be obtained, every spring, from each animal wintered in the yard. If the manure from the horse-stables, and from stalled neat cattle, be added, the quantity will not only be proportionally increased, but the quality improved. Whenever the yard is thoroughly cleaned for spring crops, it ought to be again bedded with fresh earth, and well littered.

2d. *The stables*, whether occupied by horses or cattle, may be made to contribute much to the value of the yard

dung, by their urine, which may be conducted into the yard by paved or other conduits, leading from the stables to the yard. In these, too, litter may be as profitably employed to increase the dung, and to promote the health and comfort of the animal, as in the yard or open sheds. The dung from the horse-stables, if suffered to lie in mass, is apt to heat and become *fire-fanged*, as it is termed, which very much impairs its quality. Where there are cellars under stables, the dung is thrown down into them, and is there protected from the wasting influence of the weather; but even here it is liable to suffer injury unless hogs are permitted to root among it, or unless the cellar is frequently cleaned out. An approved practice is, to scatter the dung from the stables over the cattle-yard, which thus retards fermentation, prevents waste, and produces a homogeneous mass of excellent manure.

3d. *The hog-pen.* Hogs are excellent animals for manufacturing manure, if they are furnished with the raw material, as peat earth, straw, weeds, &c., and a suitable place for conducting the process. The composts of their formation are among the cheapest and the best that are used upon the farm. The slops of the kitchen, the weeds of the garden, the refuse fruits of the orchard, and the offal of the farm, are readily converted, by these swinish laborers, into meat or manure. Hogs are profitable laborers, and should be employed to as great an extent upon the farm as the proprietor's circumstances will permit.

4th. *The sheep-fold* may be made an abundant source of fertility to the farm. Economy in its management consists in giving abundance of litter, repeated at short intervals, sufficient to absorb the urine, prevent wasting exhalations, and secure health to the flock—and in applying the dung in its recent or unfermented state.

5th. *Composts.* These are an artificial mixture of vegetable or animal matters, with earthy or mineral substances, and may be profitably resorted to in two contingencies, viz., first, to arrest and detain, for useful purposes, fertilizing matters which might otherwise be wasted and lost—as the urine of animals, or the gaseous matters

which are evolved from animal or vegetable substances while undergoing fermentation. And, secondly, to render soluble, or available as the food of plants, matters which are not already so, as swamp earth, woody fibre, &c. There is nothing *added* to the elements of fertility by mixing organic with inorganic matters in a compost-heap. The advantage in one case is in *saving* that which would otherwise be lost ; and in the other, of rendering *useful* that which is otherwise *useless*. Earthy matters absorb and retain the fertilizing properties of liquids and gases, if placed in juxtaposition, or in contact with them, and impart them again to growing plants. Thus a fermenting dung-heap will enrich the stratum of earth with which it is covered, by the gases which it gives off ; thus the earthy matters with which we bed our cattle-yards become rich in the elements of fertility, by the urine and juices of the dung which they there imbibe ; and thus the inert, insoluble matter of peat-swamps is rendered soluble and enriching, by bringing it in contact with recent manure, or other heating and fermenting substance. It is the business of the farmer to calculate, upon the foregoing principles, and upon the proximity and cost of the materials, to what extent composts may be made profitable in the economy of the farm. To some they are highly useful ; while to others, like Franklin's whistle, they may cost too dear.

There are several other animal and vegetable substances, which every farmer has more or less at command, or which he may have at command, besides his cattle-dung, which may be made to contribute largely and economically, to keep up and increase the fertility and products of his lands. We will notice some of them briefly in detail.

1. *Bone-dust*, or crushed bones. The bones of the ox, according to Davy, consist of 51 parts in 100 of decomposable animal matter, 37 of phosphate of lime, 10 of carbonate of lime, and 1.3 of phosphate of magnesia. All these matters impart fertility, and are necessary elements in the food of plants. They are species of concentrated, or portable manure : *concentrated*, inasmuch

as two bushels of bone-dust, or crushed bones, properly applied, will, upon some soils, do as much good as a load of barn-yard manure; *portable*, because they may be transported at one tenth the expense of their equivalent of yard-dung. Bone-dust is comparatively a new manure, at least in the United States, though it has been long highly prized, and extensively used, in Great Britain. Such have been its magic effects in British husbandry, and such the increasing demand for it there, that bones to the value of more than \$800,000, it is said, are annually imported into that country, to enrich the soil, in addition to those which the kingdom furnishes; and it is announced in one of her late agricultural periodicals, that the use of this manure is actually adding sixteen millions of bushels of grain annually to her agricultural products. This great source of fertility is now engaging the attention of the American farmer, and some mills have been put in operation near Boston, New York, Albany, Waterford, &c., and there is no doubt but the use of this fertilizing material will be rapidly and profitably extended. We shall speak further of its importance, and the modes of applying it, in a chapter appropriated to this subject.

2. *Horn-shavings*. These consist of the chips and refuse of the horns and hoofs of neat cattle, from comb-factories. Although more limited in quantity than the bones of animals, they may be had in considerable amount, and are equal, and, according to Davy, superior, to crushed bones, in their fertilizing influence upon the soil. From 500 grains of ox-horn Mr. Hatchet obtained only 1.5 grains of residuum, and not quite half of this was phosphate of lime—the residue being decomposable animal matter. “The animal matter in them,” says Davy, “seems to be of the nature of coagulated albumen, and it is slowly rendered soluble by the action of water. The earthy matter in horn, and still more that in bones, prevents the too rapid decomposition of the animal matter, and renders it very durable in its effects.”—*Ag. Chem.* With these may be classed the piths of horns, or the residue of cattle’s horns after the comb-maker has taken all

that is fit for his use. These may be either cut into pieces upon a block, with an axe, so as to be readily buried with the plough, or broken in the bone-mill. We have used fifteen wagon-loads of piths in a season with great advantage.

The best way of applying the bone-dust and horn-shavings and horn-piths, that we have tried, is to keep them dry till a short time before they are wanted—then to mix them, in the proportion of a bushel to a load, with unfermented yard or stable dung, to cart to the field, spread broadcast, and immediately cover the whole with the plough. The action of the dung brings on a decomposition of the animal matter, without previous preparation, and its benefits are imparted to the coming crop. We estimate fifteen loads of manure, thus charged with bone or horn, equal to twenty-five loads without it.

3. *Poudrette* is the contents of privies, dried, and rendered as inodorous and inoffensive, by chemical process, as the common earths. This is another species of concentrated manure nearly as powerful as bone-dust; more operative upon a first crop, but less durable in its effects. It is the most efficient, in its immediate effects, of any manure we have tried. It is applied at the rate of 40 bushels or less to the acre, upon all arable crops, to be sown broadcast, superficially covered, or placed in the hill or drill of hoed crops. It has long been used about Paris, has become an article of commerce, and is transported to every part of the interior. Manufactories of *poudrette* have been established in the vicinity of New York, and the demand for the article increases with the supply. Like manufactories will, no doubt, ere long be established near all our large cities; and thus, what would be otherwise a nuisance, and the indirect cause of disease and death, will be converted into vegetable food, and become a source of comfort and of wealth. Let not the sensitive start at this suggestion—the choicest delicacies of the table come from a nauseous mass of animal and vegetable putrefaction!

4. *Urette* is animal urine, absorbed and rendered dry by mixture with calcareous earth. It possesses the like

fertilizing virtues as *poudrette*, and is applied in a similar way, and with very similar effect.

5. *Woollen rags*, and the flocks and sweepings of woollen-factories, constitute a highly-concentrated manure, and are procured in considerable quantities at the woollen-mills.

6. *Fish* are converted into a valuable manure, and are a main dependance of fertility on some parts of Long Island, and other districts near the margin of the sea. These are most economically used in the form of a compost—the earth with which they are blended absorbing the volatile parts, and permitting a more equal distribution of the fertilizing matters upon the soil.

7. *Sea-weed*, or sea-drift, which is so often thrown upon the beach in immense quantities during a storm, is beneficially employed as a manure, not only on account of its vegetable, but of its saline properties. It is employed in composts, in litter for cattle-yards, or is ploughed in in a green state.

8. *Peat earth*, or swamp muck, is vegetable food, in an insoluble state, and requires only such a chemical change as shall render it soluble, to convert it into an active manure. This change may be effected in the cattle-yard, in the compost-heap, or by admixture with alkaline substances, as lime, ashes, &c.

This earth is generally insoluble in the places where it is deposited, especially when saturated with water. It sometimes is rendered soluble by thorough draining, and by the admixture of sand or loam, and always by being brought in contact with fermenting animal or vegetable matters.

9. *Peat ashes* are valuable as a top dressing for grain or grass, and particularly for young clovers. They however differ much in their fertilizing properties, according to the proportion of sulphate of lime and other salts which they contain. The peat or bogs should be burnt in stacks or piles, the fire being kindled in the centre, where dry combustibles should be placed for the purpose; and when the fire has got firm hold of the peat earth or bogs, it should be prevented from breaking out, by the occasional addition of fresh turf or bogs to the outside. The more

the air can be kept out, and the smoke kept in, the more abundant and fertilizing will be the ashes.

10. *Wood ashes* are beneficial to most soils, on account of the potash and other salts which they afford. *Leached ashes* are in many cases beneficial, particularly within the influence of the marine atmosphere; and it has been shown by a writer in the *Cultivator*, that their unvarying efficacy upon the borders of the sea, is owing principally to their combining these with the muriate of soda, or common salt. An admixture of a small portion of salt, or salt water, with leached ashes, in the interior, gave to them highly-enriching qualities; whereas, applied without the salt, they imparted little or no benefit. On many lands in the interior, however, the application of leached ashes has induced an increase of fertility.

In short, there is no animal or vegetable matter, upon the farm or elsewhere, but is convertible into farm-crops, when properly managed.

As the grain, roots, and forage destined to feed the family and the farm-stock, require the best care of the husbandman, to prevent waste and injury, so does the manure which is destined to feed his crops. Fermentation, if suffered to exhaust its powers upon yard-dung, materially lessens its value; the wind and the sun dissipate its virtues, and rains leach it and waste its fertilizing powers. The same care given to the food of vegetables, which should be given to the food of animals, will be richly recompensed in the increased product of the harvest.

If we contrast the common with the improved practice, in regard to the management of dung, we shall readily see, that the difference, in enriching the soil, is incalculably great—enough to induce poverty in one case, and to enrich the proprietor in the other. Even the best class of our farmers, who are deemed judicious managers, seldom avail themselves of half the resources of fertility which their farms or neighborhoods afford—not half that are put in successful requisition by the farmers of Great Britain and Flanders. Besides, what manure they do make, is badly husbanded: they suffer the gaseous portions to



waste in the air, instead of being absorbed by, and enriching the soil; and the liquids to course down hill to the highway or some neighboring brook. But what shall we say of the mass of our farmers? We have travelled hundreds of miles to the west, and seen great quantities of manure, in the yards and about the barns, often the accumulation of years, seemingly considered by the owners rather as an encumbrance, or a nuisance, than as a source of fertility and wealth.

In the new system of husbandry, the farmer's profits are in a measure graduated by the quantity of manure he is enabled to produce from his farm. In the fourth volume of the *Cultivator*, estimates are given, from high authorities, of the amount produced upon farms in Great Britain. Doctor Coventry, Agricultural Professor in the Edinburgh University, gives four tons of manure to each acre of straw manufactured by farm-stock. A Berwickshire farmer, quoted by Sir John Sinclair, obtained four cart-loads, of 30 to 35 cubic feet each, from every ox wintered upon straw and turnips. Meadow land is stated to produce from four to six tons of manure to the acre; and the available sources of fertility upon a farm, if the products are consumed by the stock on the farm, are estimated to be sufficient to give a full supply of manure once in every course of the four-year system of husbandry. Arthur Young, with six horses, four cows, nine hogs, and suitable litter, made 118 loads of dung, 36 bushels each, in a winter. Cattle fed with turnips are computed to make double the manure that those do which are fed upon dry fodder alone; and an acre of turnips, with an adequate quantity of straw, has produced sixteen cart-loads of dung. It will be readily perceived, that by this mode of management, ample means may be provided for keeping up the fertility of the soil, when put under the four-shift system of husbandry.

What now is the common quantity of manure, under the old system? Taking our State, or our country at large, we are confident the average quantity which is judiciously applied, will not amount to one load an acre, and we are doubtful if it will amount to half a load. Can it be won-

dered, then, that under such reckless management, of returning to the soil only a quarter, or an eighth, of what we take from it, of the food of plants, our lands should continue to grow poor, till they no longer yield a reward to culture? The cultivated lands in New York are estimated at eight millions of acres. On the supposition that one half of these are appropriated to tillage and meadow—and this is a low estimate—we might produce, and apply annually, under the new system of husbandry—and we ought to do so—sixteen million tons of manure, worth, to the country, at a low computation, sixteen millions of dollars;—whereas, we now produce, under the old system, certainly not more than four millions of tons—thereby suffering an annual loss, independent of the certain and constant diminution in the product and value of our lands, of twelve millions of dollars, in the single item of manures! This is not a visionary speculation—it is sober truth—and we ask any intelligent man, to show, from facts, a less favorable conclusion.

But, to relieve this sombre picture, so discreditable to American husbandry, we are happy to have it in our power to cite some illustrious exceptions to the conclusions we have drawn; which go to prove both our general neglect in this branch of rural economy, and the vast benefits which it is capable of dispensing when duly attended to. Among other notable examples which might be mentioned, we state, on the authority of the Essex Committee on Manures, that in Plymouth county, when a premium was to be given to the man who made the greatest number of loads of manure on his farm, the prize was awarded to a farmer who made 798 loads—the lowest competitor claiming for 350. William Clark, Jr., of Northampton, with an average stock of 8 oxen and cows, 3 horses, and 8 hogs, made in a year 920 loads. A friend of the writer on Staten Island, who has a stock of some 20 or 30 cattle, assured us that he could or did make, from his cattle, peat earth, peat ashes, and sea-weed, enough manure to thoroughly dung more than one hundred acres of his farm annually.

The cases we have cited will serve to show, that a

vast improvement may be made in this branch of farm economy.

We will merely remark here, in regard to the application of manures, that if used in an unfermented state, they should be buried with the plough, at least so deep as to remain saturated with moisture, a material agent of decomposition, and applied to a hoed, or autumn-ripening crop. If used in a rotted state, they may be blended with the surface, and applied to a summer-ripening crop. We will give our reasons for this practice. Manure fertilizes in two ways—by the gaseous matters which are evolved in fermentation, and which *rise*; and which, besides constituting vegetable food, operate in the soil, like yeast in dough, rendering it porous, and permeable to heat, air, and moisture; and by liquid matters, which *sink*. If used before it has parted with its gases, manure should be buried, that the incumbent soil may imbibe the gaseous elements. If the manure has been rotted, it has parted with its gaseous matters, and all its remaining fertilizing properties are liable to be carried down by the rains—hence this may be deposited near the surface. Again, fresh manures, even in a liquid form,\* induce a rank growth of *herbage*; but they do not produce good plump *seed*. Hence, if applied to common small grains, they cause a great growth of *straw* at the expense of the *grain*; fermentation being most rapid at mid-summer, when the seed, and not the straw, requires the food. But the autumn-ripening crops, as corn, &c., are in that state, at mid-summer, which requires strong food to perfect their stalks and leaves; and the fermentation of the manure has subsided before the *grain* matures in autumn. Fossil manures, as lime, marl, and gypsum, are applied upon the surface, or buried superficially, because their disposition is to settle down, and they give off no gaseous food.

\* Colonel de Courteur (see Farmers' Magazine) tried stable manure and liquid manure, the latter diluted, upon his wheat. The grain tillered much, or gave a great growth of straw and grass; but the product in grain was diminished. When the liquid manure was applied a second time, by being poured upon the growing wheat, the straw was very rank; the plants produced only a few ears of wheat, and those were very defective in grain.

## CHAPTER X.

## IMPROVEMENT OF THE SOIL BY MINERAL MANURES.

ALTHOUGH animal and vegetable matters are considered the true food of plants, as they are of animals, yet the plant, like the animal, is benefited by certain mineral and saline substances, which seem necessary to both, as stimuli or condiments, and which act either upon the food, in fitting it for use, upon the organs of digestion or nutrition, or become essential in giving form, strength, and firmness to the animal and vegetable structure. Thus the bones of animals are formed from the lime and phosphorus which are taken in with the food. Without lime, the eggs of fowls would be without a shell. All the earths enter more or less into the animal and vegetable structures, and into the seeds of the latter. Lime is found in the wheat, gypsum in the clover, sulphur in the turnip, silex in the stalks of Indian corn, and most of the cereal grasses. Mineral substances are also beneficially employed in improving the texture of the soil, and in fitting it to promote the growth of plants.

The most important of the mineral applications is lime. Lime benefits in two ways; first, in its caustic state, deprived of its carbonic acid by fire, it dissolves vegetable fibre, and converts it into the food of plants; and at the same time, by forming new chemical compounds with matters that are soluble, it prolongs the nutritive action of soft vegetable and animal substances beyond the time in which they would have acted, if they had not entered into a combination with it. Hence, caustic, or quicklime, should not be applied with common dung, but to soils abounding in peaty, fibrous, and other insoluble, inert vegetable matters. And secondly, in its mild state, or as a carbonate, it improves the mechanical texture of sands and clays; rendering the first more compact and more retentive of manure and moisture, and the latter

more porous, and more permeable to the dews, to air, and to heat. Upon all soils which do not contain it naturally, mild lime may be applied with certain ulterior benefit.

Lime, says Professor Low, may be applied to land in different ways, and at different periods.

“ 1. It may be laid on the surface of land which is in grass, and remain there until the land is ploughed up for tillage, even though this should be several years afterwards. The lime, in this case, quickly sinks into the soil, and, acting upon it, prepares it for crops when it is again tilled.

“ 2. It may be spread upon the ground, and buried even by the plough, just after a crop of any kind has been reaped. In this case it prepares the soil for succeeding crops.

“ 3. It may be spread upon the surface even where plants are growing. This practice, however, though sometimes convenient, is very rarely to be imitated.

“ 4. It may be, and is most frequently, applied during the season in which the land is in fallow, or in preparation for what are termed fallow crops.

“ 5. It may be mixed with earthy matter, particularly with that containing vegetable remains, [the ligneous, woody and peaty ;] in this case it forms a compost.”—*Low's Elements, &c.*

Quicklime adds nothing to the elements of fertility ; it merely digests these elements, or renders them soluble. Hence its tendency is to exhaust these elements in the soil, and to induce ultimate sterility, unless organic matters are returned to it. Lime will produce no benefit to soils in which there are no organic matters.

The quantity of lime to be applied to the acre, will depend upon the quality of the soil ; the poorer the soil, the less should be the application. In Britain, from 100 to 300 bushels are applied. In the United States, from 50 to 120 bushels ; and the dressings may be repeated, according to circumstances, in every four to ten years. In France, applications of from three to ten bushels are made annually, with the best effect. Lime is inoperative upon all soils containing an excess of water. It eradi-

cates sorrel, corrects the acidity of soils, neutralizes the oxydes of iron, tends to prevent rust in the small grains, and to give to wheat a fine, clean straw and berry.

Quicklime, in its ultimate, and carbonate of lime, in its immediate effects, are beneficial, as we have stated, in all soils in which it is deficient. Two per cent. of carbonate of lime, in the tillage stratum of a soil, is deemed sufficient, by Mr. Ruffin, for all tillage crops; but it should be borne in mind, that this earth, more than any other, is exhausted by cropping; and that when it is supplied artificially, it will require to be repeated at intervals of four to eight years.

The following rules for the application of quicklime are given in British husbandry, and will be found generally applicable to our practice.

“ 1. Before application of lime, the land should be thoroughly drained and laid dry.

“ 2. It may be carried on when the teams are most at leisure; but summer is the best season; and it never should be laid upon the land except in dry weather.

“ 3. It should be laid on while in a powdery state, and kept as near the surface as possible, as then best adapted to mix intimately with the soil.

“ 4. It may be applied either quick or effete; but if in the former state it will have more effect in cleansing the land, and a less quantity will serve the immediate purpose. It should however be carted upon the land as soon as possible, and spread directly before the plough, letting that follow so quickly, as that the body of the lime shall be slaked in the soil; and it must be cautiously applied to light soils.

“ 5. As it has a tendency to sink into the ground, and it is important to preserve it near the surface, it should be ploughed with a shallow furrow.

“ 6. When found, after a few years, in lumps, and much below the surface of the land, it should be ploughed up and repeatedly harrowed, so as to insure its entire mixture.

“ 7. Clays and strong loams require a full dose; but for sands and other light soils, a much less quantity of

lime will serve, each in proportion to the strength of the lime and the land.

“ 8. If the land be not supplied with the same quantity of putrescent manure that is usually laid upon other soils, the crops will suffer ; and if it be not then laid down to grass for a long series of years, it will be worn out and exhausted.”

We add the following from Professor Low :—

“ Lime may be laid on the surface of land when it is in grass, and remain there till the land is ploughed up for tillage, even though this should be several years afterwards. The lime, in this case, quickly sinks into the soil, and, acting upon it, prepares it for crops when it is again tilled.”

“ It may be spread upon the surface even when plants are growing. This is, however, rarely to be imitated.”

Lime is most extensively used in East Pennsylvania, of any part of the United States. The writer of this essay addressed a letter to Dr. Darlington, of Chester county, propounding certain queries as to the mode of applying lime, quantity applied, &c. in his neighborhood ; to which the Doctor kindly returned the subjoined answer, which will probably afford the best guide to the American farmer, in the application of this mineral, that can be found.

DEAR SIR,—I proceed, with great pleasure, to furnish you with such facts and remarks as my opportunities for observation have enabled me to offer. With a view to render the answers more explicit and satisfactory, I will annex them, seriatim, to your several inquiries.

*Query 1. “ Upon what lands does lime operate most beneficially,—1st. In regard to geological formation,—as primitive, transition, secondary, and alluvial? 2d. In reference to the soil,—as sand, clay, lime, and vegetable matter? 3d. As indicated by natural growth of timber and plants?”*

*Answer.* My residence has always been in a *primitive* region, and my observations very much limited to agricultural processes in soils upon that formation. The pre-

vailing rock here is gneiss, with occasional beds, or veins, of hornblende, greenstone, and sienite. About five miles to the north of us is the great valley of transition limestone, stretching from northeast to southwest, and immediately on the northern side of this valley, running parallel with it, is a broken ridge of hills, formed of mica slate,—with beds of serpentine rock and hornblende, on the side next to gneiss rock, on the southeast.

Over the gneiss rock, and among the hornblende, the soil is generally a still loam ; and I think the best effects are perceptible from a given quantity of lime. On the soil overlaying the schistose rock, the good effects of lime are sufficiently obvious, under the management of skilful farmers ; but the benefits seem to be less permanent.

On the serpentine rock the soil is extremely sterile ; and neither lime nor barn-yard manure can be used with much advantage. In the limestone soil of the great valley, where one would suppose it was already redundant, lime is used with advantage ; and much heavier dressings are put on, than in the adjacent districts. I cannot furnish the *rationale* of this practice, but I believe the fact is established, that more lime is required to produce the same beneficial effect on soils resting on limestone rock, than upon those overlaying gneiss, and perhaps some other primitive rocks.

I have had no opportunity to witness the effect of lime upon *secondary*, and strictly *alluvial*, formations ; but the circumstances have led me to suspect, that the *same quantity* of lime would not be so signally beneficial in secondary, as it is in certain primitive formations.

Lime undoubtedly has a good effect in soils which are *sandy*, even where sand predominates ; but I believe its meliorating properties are most conspicuous in a *clay* soil,—or rather in a *stiff loam*. A good proportion of decomposed vegetable matter adds greatly to the beneficial effects of lime ; and hence our farmers are desirous to mingle as much barn-yard manure as possible with their lime dressings,—and to get their fields into what is called a good sod, or turf,—full of grass roots. *Then* a dres-



sing of lime has an admirable effect.\* The soils indicated by a natural growth of black oak, (*quercus tinctoria*,) walnut, (*juglans nigra*,) and poplar, (*liriodendron*),—and those in which such grasses as the *poas* and *festucas* best flourish, are generally most signally benefited by the use of lime. In short, I may observe, that lime has been found more or less beneficial in every description of soil in this district.

It is most so on hilly or rolling lands, where clay predominates,—less permanently so among the mica slate,—and least of all on the magnesian rocks. The soil on these last is rarely worth cultivating.

*Query 2.* “*What quantity of lime is applied to the acre, upon different soils, at a single dressing, and during a period of years ?*”

*Answer.* The quantity of lime, per acre, which can be used advantageously, varies with the condition and original character of the soil. Highly-improved land will bear a heavier dressing than poor land. On a soil of medium condition the usual dressing is 40 to 50 bushels per acre. A deep, rich soil, or limestone land in the great valley, will receive 70 to 80 (and I am told even 100) bushels to the acre with advantage. On very poor land, 20 to 30 bushels per acre is deemed most advantageous to commence with. It is usually *repeated* every five or six years—i. e., every time the field comes in turn to be broken up with the plough ; and as the land improves the quantity of lime is increased. The prevailing practice here is, to plough down the sod, or *ley*, in the fall or early in the spring—harrow it once—and then spread the lime (previously slaked to a powder) preparatory to planting the field with Indian corn. Every field, in rotation, receives this kind of dressing ; and as our farms are

\* The yard manure is not usually mingled with the lime, when the latter is first applied. The practice is, to lime the *Indian corn* ground, prior to planting that grain, on the inverted sod,—and, the ensuing spring, to manure the same field for a *barley* crop,—or, to reserve the manure until the succeeding autumn, and apply it to the *wheat* crop. It is not well settled which of these is the better practice. Each has its advocates ; but it is most usual to reserve the manure for the wheat.

mostly divided into about half a dozen fields, the dressing of course comes once in six years, more or less, according to the number of the fields. Some enterprising farmers however give their fields an *intermediate* dressing, *on the sod*, after they come into grass, which I consider an excellent practice,—tending rapidly to improve the condition of the land.

*Query 3. “Is it applied in a caustic or in an effete state?”*

*Answer.* It is usually obtained in a caustic state from the kiln,—deposited in heaps in the field where it is to be spread, and water, sufficient to slake it to a powder, is then thrown upon it. As soon as slaked it is loaded into carts, and men with shovels distribute it as equally as possible over the ground. It is generally considered best to put it on the ground while it is fresh, or *warm*, as the phrase is; and it is certainly easier to spread it equally when in a light, pulverized state, than after it gets much wet with rains. I am inclined to think, too, it is better for the land when applied fresh from the kiln.

*Query 4. “To what crops is it most advantageously applied, and at what season?”*

*Answer.* It is usually applied, as already intimated, to the crop of *Indian corn*, in the spring of the year—say the month of April. Occasionally it is applied preparatory to sowing wheat in autumn. When used as a *top dressing*, on the sod, it is generally applied in the fall—say November. The prevailing impression is, that it is most advantageously applied to the Indian corn crop; and hence the general practice. But the truth is, it is highly advantageous at any, and at all seasons; and our shrewd old farmers have a saying—“*Get your lime on for your corn, if you can,—but be sure to get it on the land some time in the year.*”

*Query 5. “How is it incorporated with the soil—by the plough or the harrow? and is it applied in any case as a top dressing to grass and to grains, and with what effect?”*

*Answer.* As already stated, after the sod is ploughed down for Indian corn, it is usually harrowed once to

render the surface more uniform. The lime is spread as equally as possible over the field, and then the ground is well harrowed in different directions, in order to incorporate the lime with the soil. Soon afterwards the field is marked out and planted with corn. The plough is rarely if ever used for the purpose alluded to. I have mentioned above, that lime is occasionally used as a top dressing for grass. It appears to be particularly beneficial to that crop; and answers extremely well when applied in that manner. The practice of applying it to Indian corn as above related, is, however, chiefly followed; and the application of a dressing to each field, in rotation, causes as much labor and expense every year, as our farmers generally are willing to incur. Lime has rarely been used as a top dressing to *grain* crops within my knowledge.

*Query 6.* “*What is the ordinary cost per acre of liming, and the relative profits, in increased products of a period of years?*”

*Answer.* Quicklime, at the kilns, usually costs twelve and a half cents a bushel. The farmers generally haul it with their own teams; and the additional expense depends, of course, materially upon the *distance*. It is frequently hauled by them a distance of eight, ten, and even twelve miles. The average, perhaps, is about five or six miles. It is delivered to me by the lime-burners, (a distance of near six miles,) at 18 cents a bushel. At the rate of 40 bushels to the acre, the cost, at 18 cents, would be \$7,20 per acre. It is difficult to estimate, with precision, the relative profits in increased products. But I can safely say, from my own experience, on a small farm of middling quality, that two dressings of lime at the above rate, in the course of eight or nine years, have more than trebled the products of the land to which it was applied, both in grain and grass. It is to be understood, however, that the system of *ploughing only so much ground as could be well manured* was adopted at the same time. I may also observe, generally, that the farmers of this district, (who are shrewd economists,) are so well convinced of the beneficial effects of liming, that,

costly as its application seems to be, they are unanimous in sparing no effort to procure it. Lime has been found peculiarly favorable to the growth of pasture, when the farm is otherwise well managed; and as our farmers are mostly in the practice of feeding cattle, they resort to liming as an indispensable auxiliary to successful grazing.

*Query 7. "Is lime applied with yard manures, or earthy composts, and with what results?"*

*Answer.* I have already intimated that vegetable matters, and especially yard manures, are highly important in conjunction with lime. Both are valuable even when used separately; but when *combined*, the effect is most complete. If to this be added the great secret of good farming,—viz., to plough only so much ground as can be well manured,—the state of agriculture may be considered nearly perfect.

Lime is in some instances added to earthy composts, preparatory to distribution in the fields; but it is doubtful whether the extra labor of this method is compensated by any peculiar advantages. It is not generally practised.

*Query 8. "Is powdered limestone (carbonate of lime) applied to soils; and, if so, does it induce fertility otherwise than by mechanically ameliorating their texture?"*

*Answer.* No instance of powdered limestone being applied to soils has come under my notice. I can, therefore, form but a very imperfect opinion of its utility. If it were even as beneficial as quicklime, (which I doubt,) I apprehend it could not be procured and applied with less cost and labor.

*Query 9. "On what soils, if any, in your neighborhood, is lime found to be inoperative as a fertilizing application; and the cause of its failure?"*

*Answer.* There is no soil in this district deemed worthy of cultivation, on which lime is *wholly* inoperative as a fertilizer. On some sterile, slaty ridges, and on magnesian rocks, it has indeed but a slight effect; and even the benefits of barn-yard manure are very transient. In low, swampy grounds, also, unless they are previously well drained, the labor of applying lime is pretty much thrown away. There seems to be something in the con-

stitution of magnesian rocks peculiarly unsuited to the growth of the more valuable plants. Indeed, there are patches of the soil perfectly destitute of all vegetation. Repeated attempts have been made to cultivate the bases of our serpentine banks ; but neither lime nor manure will enable the farmer to obtain more than a light crop of small grain. Neither clover nor the valuable grasses can be induced to take root and flourish in the ungenial soil. It is, therefore, almost universally neglected.

I have thus endeavored (in rather a desultory manner, I confess) to answer your queries according to my best judgement. If what I have furnished shall in any degree tend to make the subject better understood, I shall be amply gratified.

With great respect, I have the honor to be, your obedient servant,

WM. DARLINGTON.

JESSE BUEL, Esq., *Cor. Sec'y, &c.*

Lime has been long used in the agriculture of Flanders and the Netherlands, and is, according to M. Puvis, applied at intervals of ten or twelve years, at the rate of about 45 bushels to the acre. It is also applied in compost, and the older the compost the better it is considered ; and the benefits of this application last from 15 to 20 years. In some parts of France, according to the same authority, it is given, every three years, at each renewal of the rotation, at the rate of about 11 bushels to the acre, in a compost, with seven or eight parts of mould to one of lime. This compost is used upon land previous to the autumn sowing, with an equal proportion of farm-yard dung. M. Puvis recommends this practice for general adoption.

After all that has been said and written upon the application of lime for agricultural purposes, no definite rules can be laid down for its general application. Much depends upon the quality and condition of the soil. In some districts quicklime has proved of vast benefit ; while in others it has been in a great measure inoperative. Every farmer should experiment with it first upon a limited scale, and extend its use as he finds its benefits will war-

rant. Effete lime and marl are more certain in their effects, when judiciously employed. They seldom fail to benefit any soil not highly charged with calcareous earth.

In the application of all mineral manures, of concentrated animal manures, and even of yard-dung, upon which fermentation has exhausted its powers, one rule applies, viz., that they should be blended, as intimately as is practicable, with the surface of the soil, in preference to being buried deep with the plough. The tendency of all of them is to *sink*.

Lime is not only an alterative, rendering a cohesive soil more porous, and a porous soil more compact, but it changes and neutralizes many matters that often abound in soils, that are deleterious and hurtful to farm-crops;—as, for instance, some of the acids, and the oxydes of iron and other salts. In this way it destroys sorrel, and often converts a barren ferruginous soil, charged with the oxydes of iron, into one of fertility. The prevailing opinion is, that lime soon loses its caustic quality, however fresh from the kiln, when it is either spread upon the surface of a field, or buried in the soil; and that its principal benefits to agriculture result rather from its use as a carbonate, than from its caustic properties.

*Gypsum*, or *plaster of Paris*, is lime combined with sulphuric acid. Common limestone is called carbonate of lime, from the union of carbonic acid with the base. Gypsum is called sulphate of lime, from the acid which it contains. This substance exists in soils, is found in plants, and is consequently contained in manures; yet it is applied to certain crops, upon dry, sandy, and gravelly soils, with almost certain advantage—except on the seaboard—and the poorer the soil the more apparent its benefit—probably because such soils contain little or no gypsum, and have received little or no manure. Its mode of operation is yet matter of dispute. Sir H. Davy considers it a necessary element in some kinds of plants; and his opinion is strengthened by the facts, that its application proves beneficial to such crops as afford it on analysis, as clover, lucerne, Indian corn, and broad-leaved plants generally; that it is seldom of direct benefit to

narrow-leaved crops, as wheat, rye, timothy, &c., which do not yield it on analysis ; and that it produces no beneficial effect upon wet or heavy clay grounds.

Judge Peters, of Pennsylvania, and John Taylor, of Virginia, who multiplied experiments with gypsum, thought that a bushel an acre, sown broadcast upon grass lands, was a sufficient dressing. We have found two bushels an acre to be beneficial upon meadows. In arable husbandry, gypsum is either sown broadcast, before the last ploughing or harrowing, or put upon the plants in hilled or drilled crops.

*Marl* is another mineral substance which often induces fertility. It is composed of carbonate of lime, combined with sand or clay, and is deemed valuable in proportion to the quantity of lime which it contains.

*Clay-marl* occurs in beds, more or less indurated ; and is sometimes so hard as to acquire the name of rock-marl. These marls should be laid upon the surface, not in heaps, but spread, that they may be well exposed to the ripening influence of the atmosphere, and if to the frosts of winter, the better. They have been found sometimes to be injurious without this exposure. Their operation is similar to that of mild lime, though slower. This kind of marl is most beneficially applied to sandy, gravelly, and peaty soils. It gives to such soils, what they want, both lime and clay. To improve a soil, 20 or 30 loads of this marl are given to the acre ; but when the object is to change the constitution of a defective soil, doses of 300 to 400 cart-loads are given to the acre. The best way is to spread it upon the sward, where it remains until the land is brought under tillage. We have used the blue clay, containing 25 to 30 per cent. of the carbonate of lime, upon blowing sands, at the rate of 20 loads the acre, to very great advantage ; and consider its ultimate benefit greater than that of an equal quantity of stable-dung. When taken to the field it should be immediately scattered upon the surface ; the frost and weather so divide and break it down, that, when dry, it may be broken into powder, with but little labor.

*Shell-marl* is a deposit of marine, and sometimes of

land-shells, immense beds of which are found along our southern Atlantic border, and frequently in the interior, where fresh-water ponds have apparently existed, and where the marl is generally covered with a bed of peat earth. This may be applied at the rate of 25 to 30 loads to the acre; and may be spread upon stubble, upon a fallow, or upon grass. While it benefits the herbage, the mineral sinks into the soil, and prepares it, when broken up, for the arable crop. Its effects are slower than those of lime, though they are said to last longer.

A species of *green sand* is coming into extensive use in the maritime borders of New Jersey, Maryland, and Virginia, which is found of great potency in imparting fertility to the soil. Its fertilizing properties do not consist of carbonate of lime, but of potash, of which it gives on analysis about 14 per cent. It is applied like marl, but in somewhat less doses.

*Common salt* has been highly recommended as a fertilizing material, and in many cases certainly has been used with great effect; yet there do not seem to be any established rules to guide in its application. It is no doubt beneficially applied to some soils, and to some crops, while upon other soils and other crops it seems to be inoperative. It should be used sparingly, and should be mixed with manures or composts.

It has been ascertained by experiments made by Hitt, Knight, Johnson, and others, that salt is serviceable in preventing some diseases of plants, as well as of animals. In the late investigations by a committee of the British Parliament, on the question of reducing the duty on salt for agricultural purposes, it abundantly appeared, that its free use to farm-stock was the best preventive of disease; and that in several instances, where flocks of sheep had been diseased, they had been restored to health by the liberal use of this condiment. Used in moderate quantities, it is said to prevent mildew on the gooseberry, and on various garden and field crops.

Until we know more of the peculiar properties of soils, and of the operation of mineral mixtures, the only way to determine the efficacy and economy of these applica-



tions, is to experiment with them, upon a limited scale, upon our own ground. Although lime effects wonders in some districts, and upon some farms, yet in other cases it does no good. This difference is sometimes found to exist upon the same farm,—one portion becoming highly benefited by lime, and another portion not at all affected by its application. General prescriptions can with no more propriety be applied to bad soils, than they can be to the bad health of animals. What would cure the animal in one case might kill in another; and what benefits one soil in one case, might be inoperative or prejudicial in another.

The *admixture of earths*, to improve the mechanical texture of soils,—as sands with clays, and clays with sands,—is often made with advantage; and we are persuaded may be profitably carried to a greater extent, when the different kinds are found contiguous to each other. We have seen that sand, clay, lime, and organic matters are all useful constituents in a fertile soil. When one of them is deficient, it may often be supplied without much expense, and a permanent improvement effected thereby. It is on this principle that we apply lime, marl, and manures. The soil being deficient in these, or any one of them, by supplying the deficiency, we restore it to its pristine condition, and sometimes increase its prolific powers. And we are often able to render peaty lands productive, after they have been drained, by blending sand, clay, or loam, or lime, with the vegetable matters with which they abound.

From the facts given in this and the preceding chapter, it will be apparent, that we lack not the means of feeding our farm-crops, and of thereby increasing our farm-products: we lack only the intelligence and industry which are necessary to render the means efficient. Most of our old-settled districts are employing one or more of these means to renovate the fertility of the soil; but it is doubtful whether any are employing all which are at their command to effect this object. The east are depending principally upon the resources of their cattle-yard, wherever they have become sensible of the

importance and practicability of improvement. Upon Long Island, fish, drawn ashes, and street manure, with clover, and alternation of crops, are relied upon as sources of fertility and profit. In the valley of the Hudson, clover, gypsum, and alternation of crops, and mixed husbandry, have done much towards improvement, and are likely to do much more. In New Jersey, the green sand is working miracles, and stimulating the farmers to new exertions in improvement. In Eastern Pennsylvania, lime and plaster have done much. In Maryland and Virginia, marl is the efficient agent of improvement, near tide-water, and clover and gypsum in the interior. And as to the south and west, they either do not seem to know that land can wear out, or, reckless of the future, they seem determined to kill the goose which lays the golden egg. With, to be sure, many highly creditable exceptions, the tendency of the system of husbandry at present pursued in the new south and west, is to wear out the soil, as it has been worn out, in many cases, on the eastern borders of our country.

Having shown, in the last chapter, that manures are indispensable to good husbandry—that they constitute the food of plants, and tend to ameliorate and fit the soil for the performance of its important offices;—and having noticed those manures which are most available to the farmer, and indicated the mode of profitably applying them—we proceed now to the next stage of improvement.

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## CHAPTER XI.

### IMPROVEMENT OF THE SOIL BY DRAINING.

FEW improvements, of modern introduction, promise greater benefits to husbandry than thorough draining. Whatever be the earthy constituents of the soil, or whatever its richness in organic matters, no northern cultivated crop will grow and produce well on lands that are habitually wet.

In the first place, draining will reclaim, and render productive, large tracts of land, which now produce little or nothing useful, by reason of the water which covers or saturates them. In the next place, it will improve lands that are cold and wet, by reason of a level surface and retentive subsoil, and render them far more manageable and productive, in grain, roots, and the more nutritious grasses, by carrying off the superfluous water. When there is an excess of moisture in the soil, ploughing and pulverization can only be imperfectly performed, nor till late in spring, or in favorable weather—the benefit of manure is lost, and the cultivated crop is light, and more liable to be injured by late and early frosts, than it would be if the land were laid dry. From the experience of others, as well as from our own observation, we can venture to say, that by thoroughly draining lands of the above description, two weeks upon an average are gained in the getting in and the ripening of the crop, one third is gained in product, and one third is saved in the labor of tillage.

We have likened the offices of the soil to those of the animal stomach—the preparation of food. And we have said that these offices cannot be healthfully performed, by the soil, without the agency of heat and air, as well as of moisture. Now an excess of the latter excludes the proper agency of the two former. We all know that when the animal stomach is out of order, from any cause, so that the food taken upon it is not properly digested, the subsequent processes of nutrition are arrested, the animal sickens, and ultimately dies. So with the soil. If the organic matters deposited there, to feed the crop, are not decomposed, or rotted, and resolved into a liquid or gaseous form, so that they can be taken up by the spongioles, the cultivated plant will become sickly and unproductive, and the processes of healthy nutrition be at a stand. This is the case in all grounds habitually saturated with water. Hence the accumulation to excess, in such grounds, of peaty and inert vegetable matters, and their great fertility when thoroughly drained, and the vegetable matters rendered soluble; and hence the necessi-

ty of draining the wet grounds upon our farms, before we can expect to make them profitable by culture. Coarse aquatic plants, it is true, do grow in wet grounds, and in water ; but few of the cultivated crops are found to thrive where the ground is not dry, and permeable to the influence of the sun and the atmosphere.

It is not enough, that the surface of a soil be dry, or that the soil itself be dry at some seasons of the year ; it must be free from excess of water at all seasons when required to be worked, and during the growth of plants, to the depth to which their roots penetrate for food, at least fifteen to eighteen inches, to insure a healthy growth of vegetation. It is the extremities of these roots which gather the food, and which are constantly lengthening, in annuals and perennials, while the plant grows ; and if roots extend into a wet stratum of soil, the food they take up is either too much diluted, or not otherwise adapted to a healthy vegetation. Besides, stagnant water in the soil injures or destroys the fibrous parts of the roots, and unfits them for the performance of their functions. Nor is this all : lands that hold water in a wet season, become compact and hard when the water has subsided or evaporated—impenetrable alike to the roots of the crop, and the ameliorating influence of the atmosphere. Wet clays suffer most from drought. The truth of these remarks may be verified by any farmer who will compare the growth and product of crops upon wet and dry grounds.

We have no question of the economy of draining wet lands, even if they are to be kept in meadow and pasture, provided the work is well done. There are but few nutritious grasses that will thrive in a wet soil. The following simple table, says Armstrong, exhibits at a glance the present state of our knowledge on this important part of our subject.

Whole number of plants in wet meadows, 30 ;	useful, 4 ;	useless or bad, 26.
Do. dry meadows, 38 ;	do. 8 ;	do. 30.
Do. moist meadows, 42 ;	do. 17 ;	do. 25.

We have expended considerable money in this kind of improvement, and our experience has more and more confirmed our opinion of its advantages. An outlay of

15 to 20 dollars an acre in draining, has often been repaid by the extra product of the reclaimed land in two or three seasons.

Wet soils proceed from two causes, viz., first, from the rain and snow waters which fall upon the surface, which are arrested in their downward course, by an impervious stratum of earth or rock, and, if the surface is level, or nearly so, repose and stagnate there, rendering the soil compact, wet, and cold, and infertile. And, secondly, from waters which, having passed through porous strata, are arrested by an impervious stratum lower down; and, operated upon by a constant pressure, find their outlet upon the outcroppings of the impervious stratum, or are forced up again in the form of spouts and springs,—and which impart to the soil which they saturate, an excess of moisture, and a cold temperature, wholly unsuited to the growth of farm-crops.

The first object, in seeking to rid lands of surplus water, is, to determine from which of the above causes the evil arises;—and having ascertained the cause—having located the fountain of waters—the next consideration is, how to get rid of, or drain it, with the least expense, and with most benefit to the land.

A stiff soil, as one of clay lying upon a slope, or being upon a level, and having a porous subsoil, may be sufficiently freed from water by throwing the land into ridges, terminating in the lower level. These ridges may be narrow or wide, according to the tenacity of the soil, and the slope of the surface. This is one kind of surface-draining.

In hollows and other depressions of surface, where waters accumulate suddenly, from thawing of snow or heavy rains, open drains should in all cases be made; and these should be of capacity to receive all the waters which may come into them, and of sufficient slope at the sides to render their banks secure and permanent. These are also to serve as outlets to the under-drains. Surface-drains of this kind are often wholly insufficient, by reason of their not being deep or broad enough, or they become contracted from a want of care in scouring

and keeping them in order. Parsimony in draining is seldom economy in farming.

When wetness is caused by spouts or springs, rising from below, the object is to prevent the water rising to or saturating the soil, and spreading through the grounds lying below ; and the mode of effecting this is to cut a drain at the point, or a little above it, where the water from these spouts or springs seems first to affect the surface soil. Where the soil is very porous, the presence of water may not be indicated upon the surface. In this case, holes should be made down to the subsoil, at different levels, to ascertain where the fountain is. The drain should be so far sunk into the subsoil, as to make a complete channel in it for the water which it is expected to convey. Under-drains are decidedly preferable for this kind of improvement :—Because,

1. *They are most efficient.* They can be made to reach, by digging and boring, the depot of water, or water stratum, and thus to carry off the water before it approaches the surface, or pasture of plants. Open drains do this but seldom, or imperfectly, because they are not often carried deep enough, and are continually liable to obstructions, which impair their efficiency.

2. *They are most durable.* An under-drain, laid in the most approved mode, with stone or tile, will last an age, and perhaps a century. Open drains are but temporary in their beneficial effects, without periodical repairs.

3. *They are most economical.* A good under-drain costs no more than a good open drain, designed for a like purpose, and which probably does not effect so much, as the former can be carried down with nearly perpendicular sides, while the latter must be dug with sloping banks, and must embrace a width of surface corresponding with its depth—the deeper the drain, the broader it must be at the top. The cost of the stone or tile is in a manner counterbalanced by the difference in excavation. And, when completed, the under-drain will seldom require repairs, while the open one will be a constant drain upon the labor of the farm, requiring bridges and frequent

scourings and cleanings. If under-drains cost something the most, they are certainly cheapest in the end, if they are well constructed ; and they waste no land.

The only other kind of drains we shall mention, are what are termed furrow-drains. They are of recent introduction even in Europe, and particularly distinguish Scotch husbandry. They are employed upon lands which are nearly level, where there is a tenacious subsoil, to free them from an excess of water at all seasons when the ground is not frozen. The field intended to be furrow-drained is laid into ridges, of from sixteen to thirty feet broad, according to the texture of the soil, in the direction of the slope, or with such descent as to carry off the water, and under-drains are laid in every central furrow, so deep, that, when covered, the materials of the drain shall not be disturbed by the plough. A cross-drain is laid on the upper margin of the field, to catch the water coming from above, and another at the lower side, which should be six inches deeper than the furrow-drains, to receive and convey off the water from them. The effect of these drains is to enable the cultivator to work the land easier, better, and at his leisure, and greatly to increase its product. The labor and expense of this kind of drains seem great, to those who have not made them, and their economy may seem doubtful ; but we are persuaded that, after a little experience, the benefit will be found to outweigh the expense.

Wherever coarse aquatic grasses are found growing, however dry the surface may appear, the farmer may depend that under-draining will be an improvement, and if he will sink a pit, eighteen inches deep, in such places, he will in a few hours find water at the bottom.

We draw no comparison, nor do we need any, to show the difference in products and profits between a field habitually wet, and the trouble and expense of managing it, and the same field after it has undergone a thorough drainage and amelioration. In the first case it produces very little, and seldom pays the expense of cultivation. In the latter, it is often the most productive field on the farm. Every farmer, we presume, has noticed the vast dispari-

ty. If there is one to whom it is not familiar, let him make the trial, and he will be astonished at the result, and at his own want of forethought in not having made it before.

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## CHAPTER XII.

### OPERATIONS OF DRAINING.

FOR the purpose of illustrating the operations of draining, we shall consider the subject under,—

1. Draining the surface ;
2. Draining the soil ; and,
3. Draining the subsoil.

1. *Draining the surface.* Surface-water wants only a suitable channel, and a moderate inclination, to readily pass off. In case of heavy rains, it is seen that tenacious soils, upon a level or slightly-inclined surface, are liable to be flooded with surface-water, which often stands for some time in pools, destroys the seed or growing crops, and renders the soil, when dry, compact and hard. Again, in ravines, or depressed surfaces, the like evils are liable to occur, from the sudden accumulations of water, without a proper gradation of surface, and a sufficient drain to carry it off.

In the first case, the evil may be corrected by throwing the land into ridges, the modes of doing which we shall prescribe under the article ploughing.

In the second case, when large quantities of surface-water are liable to concentrate from heavy rains, an open drain or ditch is the only resort. This should be capacious enough to carry off, in its channel, all the waters that may thus accumulate. It should be from two to four feet deep, to give a sufficient descent to drain off the waters from the contiguous grounds. Its banks should have a slope of 45 degrees, that they may resist the pressure from the surface, and the action of the water ; and in digging the sides should be left solid, without being



hacked or perforated with the spade. The earth taken from the trenches should be removed from their borders, and either spread over the surface, or, if peaty, taken to the compost-heap, or to higher grounds, so as to leave a slight inclination, on each side, for the surface-waters to pass into the drain.

2. *Draining the soil*—of waters reposing upon the subsoil. The soil, if the subsoil is porous, or a considerable inclination exists in its position, may be freed from surface-water by ridging. The surplus water, in these cases, either settles down through the subsoil, or passes off through the furrows between the ridges or upon the inclined subsoil. But where the surface is nearly level, and the subsoil tenacious, under-drains must be resorted to, into which the water may settle and be conducted off, before it injures the crops or texture of the soil.

Under-drains, in cases to which we now have reference, need be but two to three feet deep, so that the material of which they are constituted shall not be liable to be disturbed by the tread of cattle, or the operations of the plough. Some fifteen or twenty inches of these may be economically sunk by the plough. The instruments for completing them, are the common spade and shovel, for throwing out the loose substances, and a pick or mattock for raising the stones and breaking the earth where hard. The sides may be nearly perpendicular, and the ditch be no broader than is merely convenient to work in. The workmen should commence at the lower, and work up to the higher ground; and so much descent should not be given as to render the bottom and sides liable to be worn away by a strong current of water.

The materials to be used for forming the drains, may be stones, tiles, or other hard substances. In drains where considerable water is expected to flow, it is advisable to form a conduit at the bottom, of four to ten inches square. Where stones are to be employed, either as a covering to the conduit, or as a drain of themselves, they should be broken to so small a size, that moles or ground-mice cannot penetrate and find a shelter among them; for if they can they will; and by opening apertures to the sur-

face, they will let in surface-water, with the earthy matters which it contains, and which will ultimately fill the interstices and choke up the drain. The stones should be broken to a size not to exceed four inches, the expense of doing which will not exceed 25 to 30 cents the cubic yard. If a stone conduit is laid, or tiles are employed, the first covering of them should be broken stone, or porous materials, to a convenient height, in order that the water settling from above, may find free access to the drain. Conduits of stone are seldom necessary in furrow-draining—it being sufficient to break and throw in stone from 12 to 24 inches in depth.

Conduits to under-drains are made by building a little wall, roughly, with stone or brick, on each side at the bottom, about 6 inches in height, so as to leave a passage for the water six inches in width and six inches high. These side-walls are covered with flat stones, as close as can be conveniently placed, and straw or litter thrown over to defend the conduit from earth and other substances which might get into it before the ground has become compact and firm. When this is done, broken stones may be thrown in promiscuously, if they are at hand, to the height of 6 to 24 inches, according to the supply and the depth of the drain; and the earth then filled in and rounded upon the surface. A drain thus formed will appear on a transverse section as in fig. 1, and after the subsidence of the earth as in fig. 2. Where the earth is

Fig. 1.

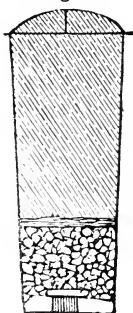
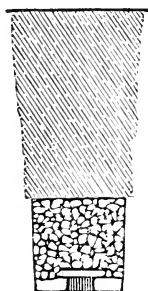


Fig. 2.



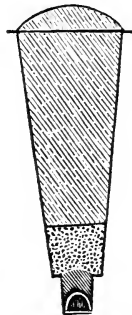
very soft, it is of benefit to bed the bottom of the drain with stones or slates, or with boards or plank.

We believe we were among the first to employ tiles in draining in the United States, though they have long been in use in Europe. We adopted them as a matter of necessity, having no stone. They are made of a peculiar kind of clay, and resemble, when burnt, red earthen. When sufficiently burnt, they are very durable. They are used with soles made of like materials, or are laid upon boards. The draining-tiles and soles are represented by fig. 3. We have laid some ten thousand feet of tiles, for which we paid \$15 per thousand feet, and find them to answer an excellent purpose. We recommend their use only where stone cannot be readily obtained.

Fig. 3.



Fig. 4.

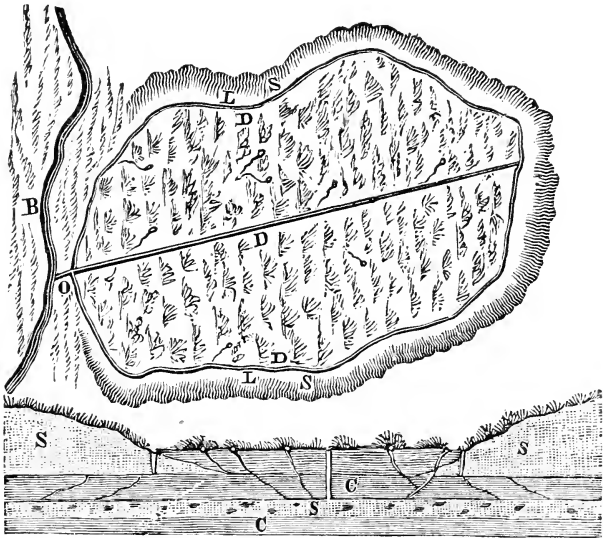


Tile drains, as seen at fig. 4, may be finished at bottom by using a narrow-mouthed spade, somewhat tapering, and broad enough to admit the tile and its sole, or a board; the tiles are then laid down close, and the joints covered with turf, or straw, or brush, and the space on the sides compactly filled, so as to prevent the passage of water there; small stones or porous earth may be then laid on, so that the water from above may pass freely into the drain, and the trench then filled with earth.

What we term soil-draining, is most frequently resorted to in swamps and low lands, into which the water collects from higher grounds, and which is prevented from passing

off by an impervious stratum below, and often upon the borders. The first object here is to make an outlet, of sufficient size and depth to carry off the water; the second to carry a main drain through the marsh or swamp; and the third to lay lateral and other under-drains, according to the extent of the ground, to collect and conduct the waters into the main drain. The under-drains should not enter the main drain at right angles, but diagonally, inclining down the stream. If waters come in from the margins of the low ground, they must be arrested then by under-drains, and conducted off, as represented in fig. 5. Care should be taken to sink the main drain, and the

Fig. 5.



Cross Section.

others, particularly those around the margin of the swamp, into the subsoil, or impervious stratum, so that the water shall not pass under the drain into the lower ground. If the surface-water that flows into the main drain be con-

siderable, it should be open, but covered in all other cases.

There is another mode, which is sometimes successfully practised, of getting rid of the water which reposes upon the subsoil, when the stratum of the subsoil is thin, and lies upon a porous gravel or sand ; which is, by boring or digging through the subsoil, so as to let the water pass into the porous stratum below. In this case the holes or pits are generally filled with stones, and the drains conducted to them.

3. *Subsoil draining*, or the drainage of waters that rise through the subsoil, or pass off at its outcroppings, as upon the declivities of hills, &c. In discussing this section, we shall principally quote from Professor Low's *Elements of Practical Agriculture*.

“ It is the intercepting of water below the surface that constitutes the most difficult part of draining, and which requires the application of principles which it is not necessary to apply in the case of surface-draining.

“ If we shall penetrate a little way into the looser portion of earth, we shall generally find a minute stratification, consisting of gravel, sand, or clay, of different degrees of density. These strata are frequently horizontal, frequently they follow nearly the inclination of the surface, and frequently they are broken and irregular. Sometimes the stratum is very thin, and a few inches in thickness, and sometimes it is several feet thick ; and sometimes the traces of stratification disappear, and we find only, to a great depth, a large mass of clay or other homogeneous substance.

“ When these substances are of a clayey nature, water finds its way through them with difficulty ; when they are of a looser texture, water percolates through them freely. These, accordingly, form the natural conduits or channels for the water which is below the surface, when finding its way from a higher to a lower level.

“ When any bed or stratum of this kind, in which water is percolating, crops out to the surface, the water which it contains will flow out and form a burst or spring, oozing over and saturating the ground, as in

fig. 6, which represents a section of the ground from C to D.

Fig. 6.

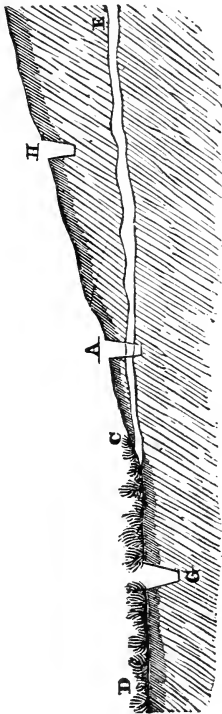
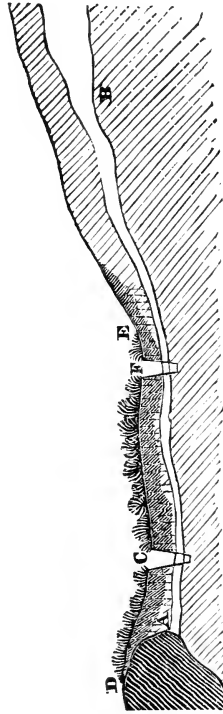


Fig. 7.



“ When water is, in like manner, percolating through one of these pervious strata, and meets with any obstruction, as a rock or bed of clay, (A, fig. 7,) it is stopped in its progress, and, by the pressure of the water from a higher source, it is forced upwards, and thus saturates the superjacent soil, as from D to E, forming springs or a general oozing.

“ In either of these cases, and they are the most frequent that occur in practice, the object of the drainer is

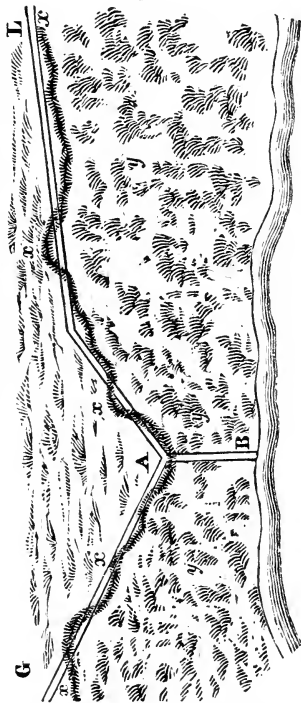
to reach the water in its subterranean channel before it shall arrive at the surface, and carry it away in a drain.

“ By cutting a drain at A, fig. 6, the water of the stratum of sand, C E, is cut off before it reaches the surface at E, where it forms the swamp, C D.

“ In like manner, in fig. 7, by forming a drain at C, or F, the water is cut off in its channel A B, and thus, in relieving the pressure from a higher source, by giving egress to the water through the drain, the cause of the wetness from E to D is removed.

“ In looking at the sloping surface of any tract of ground, as a field, in which there is an oozing or bursting out of water, we shall generally distinguish the line where the wetness appears upon the surface, extending over a considerable space, *x x x x x*, fig. 8, the effects appearing in the wetness of the ground further down the slope, as *y y y*. The line where the wetness begins, which is generally rendered perceptible by the change of color of the soil, the tendency to produce subaquatic plants, and other indications of wetness, marks, for the most part, nearly the course which the line of the drain should follow. By cutting a drain nearly in this line, as from G to A, sufficiently deep to reach the stratum in which the water percolates, we shall intercept it before it reaches the surface, and by carrying it away in some convenient outlet, A B, remove the cause of wetness.

Fig. 8.



“ This accordingly forms, in the greater number of cases, the rule adopted in practice for the laying out of drains upon the surface. The line is drawn nearly at, or a little above, the line of wetness, or, to use the common expression, between the wet and the dry.

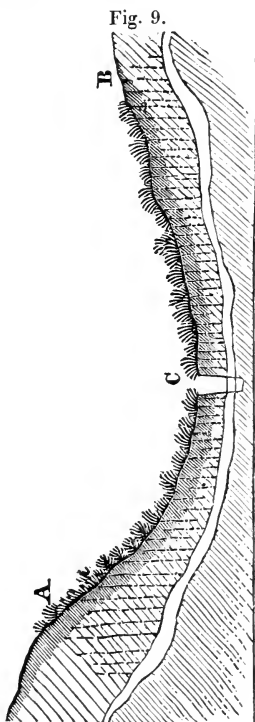
“ Should the line of drain be drawn too much below the line of wetness, as at G, fig. 5, then the trench would fail to intercept the water ; and further, if it were filled with earth, stones, and other substances, in the way to be afterwards described, the whole, or a part, of the water would pass over it, and the injury be unremoved.

“ Again, should the line be too much above the line of wetness, as at H, the drain would fail to reach the channel of the water, and so would be useless.

“ It is for this reason that, in common practice, the rule is, to clear the line of the drain nearly between the wet and the dry, or a little above it, taking care to give it the necessary descent, and to form it of sufficient depth to reach the pervious bed or stratum in which the water is contained.

“ But as the water may arrive at the surface in different ways, and the wetness be produced by different causes, so variations from this rule of lining out the drain may be required, and the judgement of the drainer is to be shown in adapting the course of his drain to the change of circumstances.

“ Sometimes in a hollow piece of ground feeders may reach the descent, as in fig. 9, and the water may be forced upwards by the pressure from each side of





the hollow, and thus form a swamp from A to B. It may not be necessary here to cut a trench on each side along the line of wetness at A and B; a single trench, C, cut in the hollow, and giving egress to the water, may relieve the pressure and remove the swamp.

“ Sometimes, upon a sloping surface, one pervious stratum, in which the water percolates, may produce more than one line of springs, as at B and A in fig. 10. Here a single drain, cut at B, will remove the cause of wetness at both swamps, without the necessity of the drain at A.

“ And, in practice, it is well to mark the effects of a drain cut in the higher part of the slope to be drained, for these effects often extend further than might be anticipated, removing springs, ooziings, or bursts at a great distance.

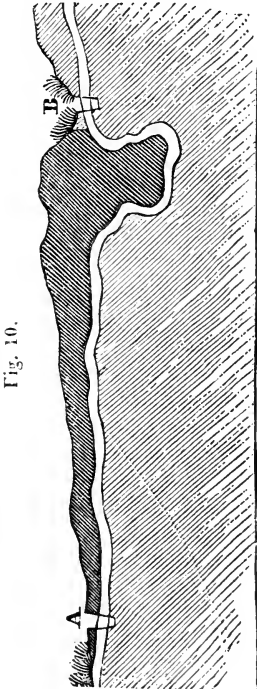


Fig. 10.

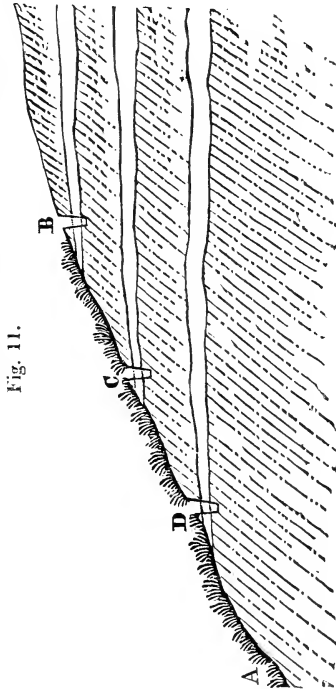


Fig. 11.

“ On the other hand, a single swamp, as from B to A, fig. 11, may be produced, and yet one drain at B may be insufficient to remove it. In this case, the water being brought to the surface by more than one channel, it is necessary to form several drains to reach the several beds in which the water is contained, as at B, C, and D.

“ These examples will show, that one rule, with respect to the laying out of drains, is not applicable to all cases, but that the drainer should adapt his remedy as much as possible to the cause of injury. One object, however, to be aimed at in all cases of under-draining, is to reach the bed, channel, or reservoir, in which the water is contained.

“ Before beginning to drain a field or tract of ground, it is frequently well to ascertain, by examination, the nature of the substances to be dug through.

“ At the upper part, where the wet tract to be drained appears, or between the wet and the dry, let a few pits be dug. The place of each pit is to be marked out nearly in the direction of the proposed line of drain, six feet long by three in width, in which space one man, and, if required, two, can work. Let the earth be thrown out to the lower side, and to such a distance from the edge of the pit as not to press upon and break down the sides. Let these pits be cast out to the depth of five or six feet, or more if necessary, so that we may reach, if possible, the porous beds in which the water is contained. Should we find no water, then let us apply a boring-rod, in order to ascertain at what depth the porous substance lies in which the water is contained.

“ Sometimes water will not be found until we come to a great depth. It may be so deep that we cannot reach it by any drain, or even by boring with the auger. In this case, we are saved the labor of making the drain unnecessarily deep. Sometimes we shall proceed to a considerable depth without finding any appearance of water, when, all at once, by breaking through some thin stratum we shall reach it. The water is frequently seen, in this case, to boil up like a fountain, and this affords the assurance that we shall succeed in our object.

“ This species of preparatory examination, by means of pits, is therefore, in many cases, useful. It affords the means of judging of the proper depth and dimensions of which the drain shall be formed ; it prevents the committing of errors in the laying out of the lines of drains ; and enables the drainer to enter into contracts with his workmen with precision.

“ When we have thus, by sinking pits in various parts of our intended lines, obtained an idea of the nature of the ground, of the substances to be dug through, and of the depth of the water, we mark our lines of drains upon the ground.

“ This may be done by pins, or by a plough drawing a furrow along the intended line.

“ It is at this time very convenient to make a hand-sketch of the piece of ground to be drained, marking each line as it is laid off in the field, and noting the depth and direction in which the water is to run.

“ The lines being marked off in the manner described, these are to form the upper edges of the drains.

“ The width of the drain at the top depends upon its depth, it being usual, except in the case of very hard and tenacious substances, to make it slope from the top to the bottom. Thus, if it be 6 feet deep, and from 18 inches to 2 feet wide at bottom, it may be  $2\frac{1}{2}$  feet wide at top.

“ But it is often impracticable to reach these substances with a drain of common depth. In this case apertures may be formed at the bottom of the drain, by boring or sinking down at the proper distances, until the pervious bed in which the water is contained is reached. By this means the water will be allowed to flow up from below into the cavity of the drain, and so will be carried away.

“ The application of this principle had been familiar from the remotest times in the sinking of wells. But it was not till after the middle of the last century that the same principle was applied to the draining of lands. This was done by Mr. Elkington, of Warwickshire, who employed the auger and the boring-rod for the purpose of

reaching the channels and reservoirs below the surface, when an ordinary drain could not reach them.

“ The auger employed for this purpose is similar to a carpenter’s wimble. It may be from four to five inches in diameter. Square iron rods are made to be screwed into each other, so that the length of the line of rods may be increased in proportion as the auger penetrates the ground. In fig. 12, A is the auger, B one of the rods, C a key for turning it round and working it, D another key for holding the rods when they are to be unscrewed by means of the key C.

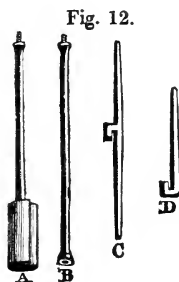
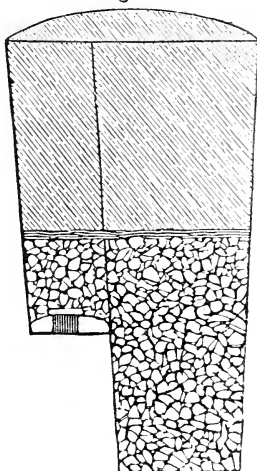


Fig. 13.



“ This instrument may frequently be found useful when the channels and reservoirs can be reached in this manner. The apertures are formed by the auger in the bottom of the drain. When the water is reached, it will spring up into the drain, in the same manner as water in the bottom of a well. It is not necessary to employ any artificial means for keeping the apertures open, as the flow of the water will suffice to maintain for itself a passage.

“ Sometimes, in place of an auger-hole, wells are sunk

at intervals along the side of the drain, and filled with stones in the manner shown in fig. 13.

“ In all cases of under-draining, the drains should be made of sufficient dimensions. They should not be less than 4 feet deep, even when the pervious stratum lies a less depth; and the reason is, that they may be more permanent, and better defended from injury, from mud and sand carried down by surface-water. It is not necessary that they be made deeper than 4 feet when that is found to be sufficient; but they must be carried, if necessary, to the depth of 6 feet, or sometimes of 7 feet, though the expense and difficulty of executing the work increase, in a great proportion, as the dimensions of the drain increase.

“ The importance, in this species of draining, of proceeding upon principles in laying out the lines of drains, instead of acting at random, as so many do, cannot be too strongly impressed upon the attention of the drainer. Every drain, however rudely devised, and imperfectly executed, may do some good. But one drain well laid out, and of the required dimensions, may perform a purpose which no multiplication of minor and insufficient drains can effect. These may lessen the effects of wetness, but the other is designed to remove the causes of it; and the more perfect practice will usually be found, in the end, to be the most economical as well as the most efficient.

“ The drains of the larger class described, it will be seen, are intended solely for the removal of water which is contained in reservoirs and channels below the surface. They do not supersede the necessity of carrying away water which is at or near the surface. From this latter cause, an equal or greater injury may arise, and must be met by a corresponding remedy.”—*Professor Low's Elements of Agriculture*.

Under-drains, for the want of stones or tiles, are sometimes constructed of other materials, as boards, plank, brush, straw, turf, &c. We have tried them all. They serve a temporary purpose, and may be resorted to as matters of necessity. But we would not advise their use

on the score of economy. In draining the rule has peculiar force, that *what is done should be WELL done*—be the object either economy, or permanent utility.

We repeat—draining is comparatively a new branch of improvement with us. Its principles are little understood, and its advantages but illy appreciated; and we are not likely to learn much in either except from experience. When we are convinced of its value, we shall persevere in it, notwithstanding repeated disappointments, till we succeed in managing it upon correct principles. The sooner we begin, therefore, the more rapid will be our progress and the greater the advantages.

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### CHAPTER XIII.

#### PRINCIPLES OF TILLAGE.

WHEN thorough draining has been effected, upon lands to be benefited thereby, there is another operation which is calculated to aid in the efficiency of manures, and in the increase of farm-products. This is good tillage—a perfect pulverization of the soil, and the keeping it free from weeds, which retard the growth of the crop, and rob it of its food. Good tillage is important, not only as it serves to exterminate weeds, to facilitate the digestion of vegetable food, and to mix and incorporate this food with earthy matters,—but as it breaks and mellows the soil, and enables the roots of plants to range freely in search of this food.

Every farmer must have observed, that when tillage has been but imperfectly performed, as is sometimes seen about stumps and rocks, and near fences, the crop is comparatively feeble and light. This is not owing to the poverty of the soil, because the plough, as it rises to the surface in these places, deposits and accumulates there the finest and best mould of the field. The feebleness of the grain arises from the imperfect tillage which these spots receive.

As we have before observed, the atmosphere and the rains are not only charged with the elements of fertility, but they are indispensable agents, together with heat, in preparing the vegetable food deposited in the soil. Complete pulverization, therefore, is essential to the full development of their enriching properties. They should not only be permitted to *enter*, but to *circulate* in the soil. Stagnant air and stagnant water soon become hurtful to plants as well as to animals.

The old practice of carrying the main furrows to the extremity of the field, and of dispensing with head-lands, is a bad and slovenly one, and ought to be every where exploded, because, under this practice, the head-lands can only be imperfectly worked. The cut-and-cover practice is still worse, as it leaves one half, and sometimes two thirds of the soil, undisturbed by the plough. We remember well, when we followed the plough in our boyhood, and knew nothing of the philosophy of ploughing, our aim was, to go over much ground, and show a ploughed surface, regarding the complete breaking up of the soil as of minor importance. There will always be a great many boys at the plough, until the importance of *good* ploughing is well understood. Good ploughing consists in turning and breaking every inch of the soil to the required depth; and good tillage requires that the harrow and roller should finish, if the plough has failed to effect, a complete pulverization. A green sward becomes pulverulent as the roots of the grasses decay, and is best without a second furrow, because this turns again to the surface, to the wasting influence of the sun and winds, the vegetable matters buried by the first ploughing, and which, if left buried, would contribute largely to the sustenance of the crop. As the roots of the grasses decay, the soil becomes loose and porous, and is permeable to moisture, air, and heat. Hence the advantage of fallow crops over naked fallows, and of depositing seeds upon the top of a clover ley; the sod then imparts fertility to the soil, while it enables it to derive important advantages from the co-operation of external agents.

Good tillage requires that, when practicable, as in the

culture of drilled and hoed crops, the surface soil should be *kept* clean while the crop is growing, for the same reason that the soil is required to be made so before depositing the seed ; viz., to facilitate the decomposition of the vegetable food, to stimulate the organs of the plants, and increase the growth and product of the crop. There is no better expedient for preventing the evils of drought upon a soil, than that of keeping the surface mellow and clean. Atmospheric air and dew, always charged with the food of plants, penetrate such a surface as into a sponge, and impart to the roots of plants both aliment and stimuli. Dews fall *upon* a hard surface, and are evaporated by the first rays of the morning sun ; but they *penetrate* a loose surface, and moisten and fructify it. Hence the high repute of drill husbandry, which enables the cultivator to keep his crops clean, and the surface of his soil mellow and open.

Good tillage has reference to *depth*, as well as quality of tith. “ There are many plants, the roots of which are found from fifteen to twenty, and even thirty feet under ground—sainfoin and lucerne, for instance ; even red clover will strike down three feet if the soil be a fertile loam ; and some of our commonest vegetables, if it be a friable or sandy, push their tap roots to about the same depth. The roots of wheat will penetrate as far as eight inches into the earth ; and when sown on the crowns of ridges, they have been found at the depth of twelve. We may therefore assume the depth of twelve inches as the utmost vegetative limit of corn land. Provided the soil be open and fertile, the nearer its depth approaches to twelve inches, the greater number of plants may it therefore be supposed capable of furnishing with support.”—*British Husbandry*, vol. ii. pp. 49, 50.

Soils should be ploughed as deep as the substratum will admit, at least once in a course of crops, if this can be reached with the force of an ordinary team ; and when the surface soil is superficial, it should be deepened, as fast as fertility can be imparted, by turning up, at suitable intervals, some portion of the subsoil. The atmosphere



imparts to this apparent inert earth, more or less of the elements of fertility.

We have a good illustration of the advantages of artificially, but gradually, deepening the soil, in the practice of Baron Von Voght, an eminent German agriculturist, who in a few years transformed a thin, unproductive soil into one of great depth and fertility.

In 1813, the Baron undertook to improve the condition of an estate denominated Flottbeck, as a pattern farm, and to make it an experimental farm for the north of Germany. In 1829, he had carried his improvements to so high a state of excellence, that he published, for the benefit of the visitors who thronged to see him, a pamphlet, developing the principles, by the adoption of which, his soil, naturally bad, had been raised to a state of high productiveness. It is from a portion of this pamphlet, for we have not seen the whole of it, that we collate the following facts.

The soil of Flottbeck is a mixture of sand and clay. Its original depth of *krume* (mould) was only three inches; the surface was uneven, and the soil wet, water standing for a long time, and manure ineffectual on account of the consequent low temperature. Fields could not be sown, owing to quagmires, often till June. The winter crops were full of tares and perennial weeds; summer crops abounded in wild radish and mustard, the clover with wild chamomile, sorrel, &c., and the fields with dog's grass, and other noxious plants. How many of our farms now form a counterpart to this description of Flottbeck!

The means of improving which the Baron instituted to raise the condition, and increase the fertility of this farm, consisted principally in—

1. Levelling the surface, and thorough drainage.

2. Deepening the *krume*, or soil, at least one inch a year, till he had gained a depth of fourteen inches—this depth being requisite, in his opinion, for the roots of plants to penetrate, and as a reservoir for moisture, to supply the crop in time of dry weather. To obtain this depth, trench ploughing (*rayolt*) was resorted to when necessary.

3. Increasing the fertility with the increasing depth of the soil, by ploughing in green crops, and by husbanding and judiciously applying manure—the latter applied to the potato and rape crops, and before it had become exhausted by fermentation.

4. Throwing the land into one-bout ridges in autumn, (it being generally flat and rather stiff,) and cleaning the intermediate furrows with a double mouldboard plough. This operation enriched the soil by atmospheric influence, broke down its stubbornness, and laid it dry, so that the spring operations could be commenced two or three weeks earlier than formerly.

5. Thorough pulverization preparatory to putting in seeds, and giving these only a superficial covering of earth.

6. Graduating, by a scale, which the Baron's long observation and numerous experiments had enabled him to contrive, the manure to be applied, to the precise demands of the soil and the crop—thus receiving the whole benefit which it was capable of imparting, without loss by excess.

7. A judicious rotation—in which green crops often intervened. The rotation was one of six years, as the clover, which he observes forms the basis of agriculture, cannot return oftener. The intermediate crops were wheat, oats, mixed fodder, barley, rye, potatoes, vetches, rape, &c., the climate of Germany not admitting the culture of Indian corn.

In 1829, Flottbeck exhibited a far different appearance from what it did in 1813. All the fields showed a level surface—the *krume* or mould had every where a depth of 14 inches. The fields were rendered dry by ditches, and the under-water was carried off by 27 under-drains—no noxious plants infested the ground, save the dog's grass, when the clover happened to be frozen out—and the produce was so much increased, that the same area, which, in 1813, would yield only 14 bushels rye, in 1829 was found to produce 24 bushels of wheat.

We think there is much in Baron Von Voght's practice that commends itself to the notice of our farmers.

The means which he employed are within our reach, and the advantages of using them manifest. The climate of Germany is not very dissimilar to ours, save that ours is rather the most mild.

That our readers may understand the principles upon which the improvements at Flottbeck were based, we subjoin them in the Baron's own words.

“The few general principles adopted here with all kinds of produce, are the fruit of thirteen years' experience, and several thousand experiments.

“1. The soil must have 11.280 to 14.000 inches of krume, in order to admit of the roots penetrating into the ground; that in wet weather, the water, which in a flat soil might drown the crops, may be absorbed, and formed in the deep into a reservoir, from which the extremities of the roots may imbibe a nourishing moisture, impregnated with carbonic gas, which it draws from the manure fermenting in the earth.\*

“The krume must have a depth of 14.000 inches, in order that the exhausted surface, being buried at a greater depth, may reimbibe the lost moisture.

“This I obtained, by having the land ploughed in autumn, to a depth of about 5.640 to 7.520 inches, then having it finely harrowed, and finally rayolt it with two ploughs, one behind the other, (the last with four animals;) this requires, of course, swing ploughs, as it is absolutely necessary to plough before rayoled.

“The latter operation is usually performed by oxen.

“2. In autumn all ditches must be opened, and all the drains examined, so that the water may not be stopped in any place.

“3. The rayolt lands must be laid in high furrows, by means of ploughing, always two furrows together, after the rayoled and furrowing, so as to make a water-fur-

\* “Thâer mentions the following proportion of the value of the soil, with a flat and deep mould. ‘If,’ says he, ‘the soil, with a mould of three inches, is worth 38, that possessed of five inches of mould will be worth 50; that of 8, 62; and that of 11, 74;’ and this entirely agrees with my experience at Flottbeck. Should we then hesitate to spend a few years, and some manure, thus permanently to enhance the value of our fields?”

row at every 16.920 inches, which is deepened and cleaned by means of a double struckbrett, [mouldboards fixed to the plough,] with a clayey soil ; this operation is *indispensable*.

“ The advantage of this mode of treatment is, that it keeps the soil dry, and renders it capable of being cultivated three weeks sooner than other shallow land ; that it avoids stiffness, and, on the contrary, the high ridges, being frozen through in the winter, are found very mellow in the spring. I cannot deny that in autumn this requires four kinds of ploughs, (the two last of which may certainly be considered as only half kinds of ploughs,) instead of one kind, generally used on large farms. Moreover, this depth of mould cannot be obtained in less than ten years, when, at the same time, the disadvantage of an inferior subsoil can be repaired by manure, which will add about one inch of mould in a year—a method quite impossible on large farms, and on small ones attainable only by a proprietor, and never by a farmer.

“ These high furrows are separated in the spring with the four-horse split plough : if the land is quite clean, it may, after being harrowed in the manner which will be mentioned hereafter, be immediately sown ; but if it is not, it is hooked [harrowed] crosswise.

“ 4. All the land which is not rayolt [trench-ploughed]—because there remains from the preceding harvest too much manure on the surface, which, *if the next crop should want it*, must not be removed too far, is, if it bears no manure crop, ploughed in autumn, first shallow, then deep, and lastly laid in high furrows. In spring, in which there is as little ploughing as possible, it is, after the splitting, according to the necessity of the crop and soil, first harrowed, and then hooked crosswise, or only harrowed in the manner prescribed.

“ 5. It is a principal maxim to sow a green crop for ploughing in, in the rape-seed stubble, as well as in the corn stubble, where no clover has been sown. In August, I use for this purpose rape-seed ; in the beginning of September, turnips ; from the middle of September to the middle of October, rye ; then there is but one ploughing

in autumn, a method which I recommend on large farms.

“ The manure crop is in the spring shallowly rayolt in, and is equal in its effects to 3.914 to 5.811 loads of manure per acre.

“ 6. One observation which leads to the most important results, was the certain conviction, that it is the vital power of plants, which, by the incomprehensible faculty of decomposition and assimilation, by means of their leaves and stalks, constantly imbibe an incredible quantity of substances, in the shape of gases and manures, and convert them into their own elements, rejecting what they do not want, changing what they have received into a new body, and so continuing until they have formed their blossoms ; that the root, which till then keeps growing and oozing out moisture, only begins when its growth is perfected powerfully to decompose that which surrounds it, and alone supports the fruit, whilst the leaves and stalks are fading ; that the vital point of the plant has its seat exactly in the centre of the germ, from which it forces the root into the earth, and the stalk upwards ; that every thing depends, in the first growth of the plant, on keeping this point in health and activity ; that this should be done in sowing,

“ 1st. When the surface is as much as possible pulverized, in order that the seed-corn or potato-shoot should be surrounded by, or rather laid on earth finely divided, in which the fibres of the root may quickly shoot, and where air, moisture, and warmth may operate with facility.

“ 2d. When the shoot, lying on such a pulverized surface, is covered only a couple of lines, in order that light, air, warmth, dew, and other atmospheric moistures may immediately excite the vitality in this point, and thereby promote the developement of the germ and procure nourishment to the first leaf.

“ I refer, with regard to this, especially, to the specimens of dried plants kept ready for the inspection of the visitors, which so strikingly show what difference there is in the vital germ lying on the surface, where roots and leaves immediately, numerously, and powerfully shoot

from one point, and the weakened vital germ, which, lying at the depth of 1.680 inches, shoots forth few roots, but a thin tube, which rises as far as the surface, where the knot is formed, whence the weakened germ pushes forth a single and sickly plant.

“The result of this observation was, that we took every possible pains to give the surface, to a depth of from 1.880 to 2.820 inches, the necessary state of pulverization, to divide the thickly-sown seed equally upon it, and to give it as thin a covering of the pulverized soil as possible. But for this we were entirely without implements.

“The grubber, indeed, gave looseness to the surface, but did not destroy the small clods. The roller pressed the soil too firmly, and, if it happened to rain, a fresh process became necessary. The usual harrow, with teeth 6.580 inches apart, drew, in a ground previously harrowed, lines in which seed sown by the best sower would fall, and then stand too thickly, while a surface of 2.280 inches was left between these lines, which contained few plants, but became a nursery for weeds.

“Then it occurred to us, (after the usual grubbing and harrowing,) to pass with the iron Mecklenburgh harrow reversed, the upper side of it being flat upon the surface, till all the small clods were pressed into a powder; then I had harrows made, the teeth of which are only from 1.410 to 1.880 inches wide apart, and in the Flemish fashion, placed in a slanting angle. With these we passed sharply over this finely-pressed soil, with the horse fastened to the middle, and afterwards to one corner, after which we sowed. The corn came to lie in lines 1.410 inches apart, and was harrowed in crosswise, with the *drag* teeth of the close harrow,\* and by this means the seed was slightly covered, and not again displaced.

“By this mode of cultivation, it was found that every germ immediately shot forth strong roots and several stems at once; and an experience of several years has shown an increase of produce of from 20 to 30 per cent. occa-

\* With the teeth slanting forward. They are called *drags* when the teeth slant backwards.

sioned by it, as we continued to cultivate a piece of ground next to it in the usual manner.

“7. I must further mention, as the last, but not less important principle and cause of success, that each of the manured fields has been brought to that point of fertility in which it can yield the greatest produce ; so that with less manure, it would not yield its full produce, and more manure would cause the crops to lie down, even if the year was not wet. The difficulty of being able to fix this point, for every field and kind of crop, with certainty, was removed by the now perfected geometrical method by which, with the help of a scale formed on twenty years’ experience, the degree of productiveness may be marked, in which the field has been left in the last crops ; i. e., seldom below 100 degrees, which denotes a field capable of yielding 24.02 bushels of wheat per acre, and below which it is not advisable to let a field sink.”

Jethro Tull and his disciples maintained, that the great secret of inducing fertility, consisted in minutely dividing and pulverizing the soil by culture ; and John Taylor, the Arator of Virginia, and an excellent practical as well as scientific farmer, considered the atmosphere as the great store-house for vegetable food, where it exists in a gaseous form. The good tillage we advocate embraces all the advantages of Tull’s and Taylor’s theories, without lessening the importance which we attach to barn-yard manure.

The deep ploughing of dry land, or the breaking up and stirring of the subsoil, promotes fertility, by increasing the power of the land to absorb water by cohesive attraction. “The power of soils to absorb water from air,” says Davy, “is much connected with fertility. This power depends in a great measure upon the state of division of its parts ; the more divided they are, the greater their absorbent power. When this power is great, the plant is supplied with moisture in dry seasons ; and the effect of evaporation in the day is counteracted by the absorption of aqueous vapors from the atmosphere, by the interior parts of the soil, during the day, and by both the exterior and interior during the night.” The soil im-

bibes heat earlier in the spring, and retains it later in autumn, in proportion as it is dry and deep,—a matter of high consideration in cold climates, where the length of the summer scarcely suffices to mature the crops. The quality and dryness being the same, a soil is fertile and durable nearly in proportion to the depth of the tillage which it receives; six inches giving nearly double the pasture for plants that a three-inch stratum does—and a twelve-inch tith greatly exceeding in productiveness one of only six inches. Von Thâer calculates this difference in proportionate degrees in lands which contain a vegetative stratum of soil of four, six, eight, and twelve inches in depth, provided, of course, that it be all of equal quality. If, therefore, each seed were to produce a plant, it would follow that ground which contains eight inches of depth of fertile mould, might be sown with double the quantity of that which consists of only four inches. He, however, admits, that this principle cannot be carried to that extent, because the action of the atmosphere must ever afford that superiority to the surface, that a cubic foot of mould, if divided into two square feet, will always produce a greater number of plants than if the seed were sown upon one foot superficial; but he assumes the value of the land to be increased, in the proportion of eight per cent., for every inch of mould beyond the depth of six to ten inches, and to be diminished, in the same proportion, from six to three inches, in soils of a thinner staple. *Principes Raisonnés d'Ag.*, vol. iii. p. 138, § 735. These considerations have been hitherto but little regarded in our practice, though they constitute an important feature in the new system of husbandry.

Good tillage demands, also, the extirpation of weeds. Every plant which grows upon a soil tends to impair its fertility, and weeds more than cultivated crops, because they are generally the most hardy, and the greatest consumers of vegetable food. They are particularly prejudicial to crops in a dry season, as they exhaust the soil of moisture in proportion to their superficies, or the surface of their stems and leaves, some species transpiring their weight of moisture every twenty-four hours. The



drill culture and deep ploughing both lessen the evil of weeds ; the first tends to destroy them, and the latter to bury their seeds so deep, as to prevent the plants getting ahead of, and choking, the young crop. Clean tillage has been too much neglected in our practice. Many crops are diminished a fourth, a third, a half, by pestiferous weeds which are permitted to seed and propagate upon the land.

In regard to some troublesome perennials, as Canada thistles, wild onions, quack grass, daisies, &c., the best means of destroying them is, to prevent the growth of leaves, their elaborating organs, which concoct and prepare their food. This is done by frequent summer ploughings, or by a succession of well-cultivated hoed crops. Good tillage requires good implements, and these to be kept in order, that the farm-work may be economically done, and well done, and done at the proper time. The disparity between old and new implements of culture is great, not only in the time employed, but in the manner in which they do their work, and in the power required to perform it. The old plough required a four-cattle team, and two hands, to manage it, and the work ordinarily was but half executed. The improved plough is generally propelled by two cattle, requires but one man to manage it, and, when properly governed, performs thorough work. Harrows and other implements have undergone a like improvement. Besides, new implements, which greatly economize the labor of tillage, are coming into use, as the roller, cultivator, drill-barrow, &c., so that a farm may now be worked with half the expense of labor that it was wont to be worked forty years ago, and may be better worked withal. Mind, likewise, where it is put in requisition, and enlightened by science, is doing ten times more in aid of agricultural labor than it formerly did.

If we revert to old, and, in many cases, present practices, we shall perceive, that thorough tillage has not been sufficiently attended to. Our implements have been defective, and the manner of using them often imperfect. Good ploughing is all-important to good farming, and still

there is no labor upon the farm that has been more imperfectly performed, than this generally has been. Light soils seldom require but a single ploughing for the seed, if well executed; but if badly executed, two ploughings are too little. Our implements are, however, daily improving; the importance of good tillage is becoming more and more apparent, and our practical knowledge is increasing.

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## CHAPTER XIV.

### OPERATIONS OF TILLAGE.

THERE are six prominent objects to be effected by tillage; viz.,

1. To break up the entire surface-stratum of soil, thereby to render it permeable to the agents of vegetable nutrition and growth, and the roots of plants.

2. To give the greatest exposure of surface to the ameliorating influence of the atmosphere.

3. To induce a pulverization of the soil, that seeds may more readily germinate and grow, and air and moisture more freely circulate in it.

4. To destroy weeds and foreign plants, that rob the crop of food, and choke its growth.

5. To effect an economical distribution of the dung, the food of the crop, by blending and incorporating it with the soil.

6. To bury the seed of the intended crop.

The principal implements employed in the operation of tillage are, the Plough, Harrow, Roller, Cultivator, and Drill.

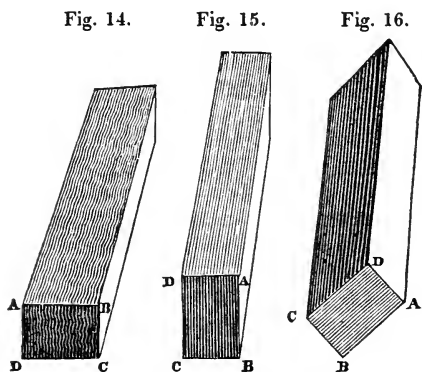
#### § 1. *The Plough.*

In order to profit from the excellent illustrations of Professor Low, in the use of the Plough, we shall copy this writer's remarks from his *Elements of Practical Agriculture*.

“By means of this instrument the earth is to be turned over to a given depth ; and this is to be effected by cutting from the ground successive sods or slices of earth, so that each sod or slice shall be raised up or turned over, in such a manner that an entirely new surface shall be exposed to the atmosphere.”

In this mode of laying the furrow, it will be perceived, the largest surface is exposed to the enriching influence of the atmosphere—viz., one entire edge, and most of both the upper and under surfaces of the furrow-slice.

In fig. 14, let A B C D represent the end or transverse section of the slice of earth which is to be turned over.

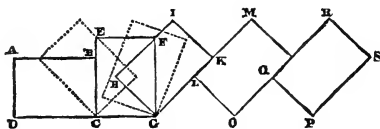


The slice is first to be raised from the position in which it lies in fig. 14 ; it is next to be placed in the position shown in fig. 15, and it is finally to be placed in that represented in fig. 16.

“In the following diagram, fig. 17, let A B C D, corresponding with the same letters in the last figures, represent a transverse section of the slice of earth which is to be turned over. This slice is first to be raised from its horizontal position A B C D, by being turned upon its corner C as a pivot, and placed in the position C E F G, corresponding with that of fig. 15 ; it is then to be turned upon its corner G, as upon a pivot, and laid in

the position  $G H I K$ , corresponding with that of fig. 16. In this manner the side  $D C$ , which was formerly underneath, will be above, namely, in the position  $H I$ ; and if successive slices be thus reversed, they will rest upon each other in the manner shown by the section of the slices  $P Q R S$ ,  $O L M N$ , and  $G H I K$ .

Fig. 17.



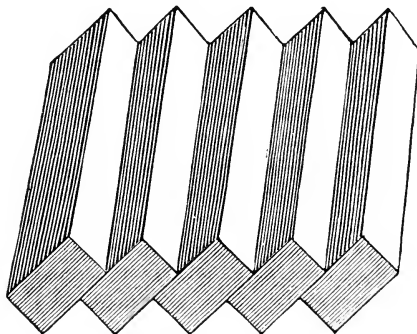
“The angle of inclination at which these different slices will naturally rest upon each other in the manner shown in the figure, will depend upon the proportion which the width of the slices bears to their depth; and that the greatest extent of surface may be exposed to the air, the angle of their inclination will be  $45^\circ$ . In order, therefore, that the slices may be at this angle, the proportion which the width of the slices bears to their depth is to be determined; and this can be done by simple calculation; for it can be shown that, the width of the slice  $A B$  being the hypotenuse of an isosceles right-angled triangle, the depth of the slice  $B C$  will be one of the sides. Supposing, therefore, the width of the sod  $A B$  to be ten inches, the depth  $B C$  will, by calculation, be 7.071 inches.

“If, then, beginning at one side of a field, we shall cut off a slice of earth, the entire length of this field, and place it in the position  $P Q R S$ , fig. 17, and then cut off a second slice, and place it in the position of  $O L M N$ , and then a third slice, and place it in the position  $G H I K$ , and so on, the various slices will rest upon each other at a given angle, in the manner represented.

“A similar operation is to be performed by the plough. Beginning at the right-hand side of the field or ridge to be ploughed, a sod, which we shall now call a furrow-slice, is to be cut from the firm ground, raised up and turned over, and so on. In this manner, an entire new

surface will be exposed to the atmosphere, and the successive furrow-slices laid resting upon each other, thus :—

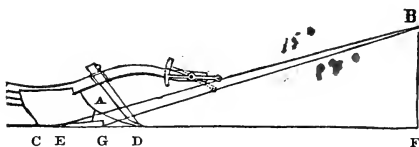
Fig. 18.



“ An essential property of the plough is, that it shall move in the earth with a steady motion ; and the giving to it the force and combination of parts necessary for that purpose is one of the main difficulties attending its construction.

“ Were it ascertained, by experiment on the plough when at work, at a given depth of furrow, and in soil of a given texture, that a cord attached to any point A, fig. 19, and drawn in the oblique direction A B, would so

Fig. 19.



pull forward the plough, that it should press uniformly upon the earth at all points, from C to D, so that the share should neither tend to point upwards or downwards, but should move horizontally forward, then it is to some part of this line that the moving power should be applied ; and further, it is known from the principles of mechanics, that it matters not, in so far as regards the force exerted,

to what precise part of this line the power is applied. Now, without entering into any mathematical investigation of the principles upon which this line is to be determined, it is to be observed, that in a well-made plough, formed on the principles pointed out, this line, drawn from the usual point of detachment of the draught on the collars of the working cattle, will intersect the sole of the plough at E, a little behind the setting of the share, and a little to the right of the plane of the left side of the instrument. →

“ Now, knowing the height at which the point of draught is to be attached to the shoulders of the working cattle, let us suppose 4 feet, and the distance from the point of the share at which the animals of draught can be conveniently yoked, let us suppose 12 feet, then laying off D F 12 feet, and F B 4 feet, and drawing B E ; it follows that the point at the end of the beam, is that to which the draught is attached.

“ But the angle which the line E B forms with the surface, is not, as can be shown, constant, but varies with the depth ploughed, and the tenacity of the soil. That the instrument may suit itself to these variations, as well as that any defects in the form of its parts may be counteracted, and that the line of draught may be placed in that portion which is required to pull forward the plough, without there being any tendency in the share to sink into the ground or rise out of it, the bridle is fixed at the end of the beam, so as to elevate or depress the line of draught, as may be required. Should the plough, for example, tend to go deeper into the earth, the line of draught is to be lowered, by means of the bridle, so that it shall form a greater angle B G F ; the effect of which will be to counteract the tendency which the plough has to go deeper. The same effect will be produced by shortening the traces by which the horses are attached to the draught, and thus increasing the angle. In like manner, by means of the bridle, the point of draught can be shifted to the right or to the left. If the point of the share tends to point to the left hand, in the firm ground, the line of draught is shifted more to the left ; and if to the right hand, it is shifted more to the right. This adjusting of the plough's

motion is easy, and is performed by the ploughman, until he feels that the plough continues to *swim fair*, to use his own technical language, that is, until he feels, which he does at once, that it continues to move horizontally forward, without any tendency to turn to the right or left, or to rise from the earth or to sink into it. A well-constructed plough of this kind, therefore, needs no wheels or other devices to steady its motion; the effect being produced by merely altering the line of draught.

“ In ploughing, it has been seen, a slice of earth is to be cut from the left-hand side, and to be turned over to the right-hand side. In this operation, the left-hand or near-side horse walks on the ground not yet ploughed, the right-hand or off-side horse walks in the furrow last made, and the workman follows holding the handles of the plough. By means of these handles he guides the plough, and he directs the animals of draught by the voice and the reins. When he is to turn the plough at the end of the ridge, or when it encounters an obstacle, as a large stone, he presses down the handles, so that the heel of the plough becomes a fulcrum, and the share is raised out of the ground.

“ In ploughing, the instrument ought to be held vertically. If it is inclined to the left-hand side, the same work is performed in appearance, though not in reality, a portion of the ground below not being tilled at all, but left thus :

Fig. 20.



“ The plough is of the most perfect form, when its various parts are so adjusted that they shall not oppose each other's motion; but it is very difficult to form a plough that is perfect in its form and the combination of its parts. Even in those of the best construction, there is frequently found to be a tendency to rise out of the ground, or to turn to one side, generally the right-hand or open side. The tendency to rise out of the ground can be corrected by giving an inclination downwards to the point of the share, and the tendency to turn to the open or right-hand side can be corrected by turning the point of the

share slightly to the left-hand side. By these means, however, the labor of draught is increased, and care must therefore be taken that this tempering of the irons, as it is frequently called, be not in any case carried further than is necessary to correct the defects of the instrument. All that is necessary beyond this is effected by changing the position of the line of draught, by means of the bridle on the beam.

“With regard to the depth to be ploughed, this, we shall see in the sequel, depends upon the kind of crop to be cultivated, and other circumstances. It has been shown that a furrow-slice of ten inches in width requires a depth of seven inches, that is, a depth of about two thirds of the width, in order that it may lie at the angle of  $45^{\circ}$ . But, although it is necessary to proceed upon this principle in forming a plough, we cannot regulate the width to the depth in this manner in practice. It is not necessary that the depth should be to the width in the proportion of two to three, or that the sod should be precisely at the angle of  $45^{\circ}$ . In the field, all that can be arrived at is a kind of approximation to the true proportions. When the sods are considerably too wide in proportion to their depth, the ploughman will be admonished of this by their lying too flat, and too slightly overlapping each other. When their depth is considerably too great in proportion to their width, they will stand too upright, and be apt to fall back again into the furrow.

“The medium depth of good ploughing may be held to be seven inches. When circumstances, as the kind of crop, and the nature of the soil, do not require deep ploughing, the depth may be less; but it will be considerable in those cases to be afterwards adverted to, when deep ploughing is from any cause expedient.

“In the moist climate of Britain, and indeed in most parts of Europe, it is necessary to form the ground into what are termed ridges, so as to admit of the water which falls upon the surface finding a ready egress. And even in lands so dry that little injury will result from stagnating water, such ridges are generally formed, on account of their convenience in the different modes of tillage.



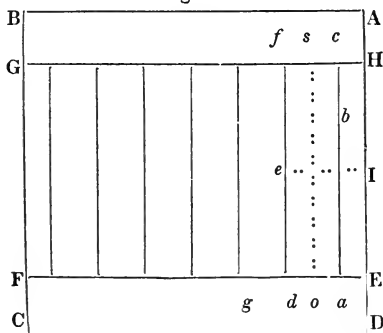
“ The first operation in the formation of ridges is *striking the furrows*.

“ Let it be supposed that a field has been laid level by previous ploughings, and that, the marks of former ridges being obliterated, the lines of the new ones are to be laid out. The usual breadth of ridges is from fifteen to eighteen feet, and sometimes more. We may assume, in the following descriptions, fifteen feet to be the width of the ridge.

“ Let a steady ploughman be furnished with three or more poles of wood shod with iron, eight or nine feet in length, and divided into feet and half feet. The first operation is to mark off, at two sides of the field, what is termed a head-land. This is merely a ridge formed parallel to the side of the field, on which the horses are to turn, to afford sufficient space for which, these ridges may be eighteen feet wide. The lines of them are marked off before the other ridges, in order that the ploughman may know when to turn his horses. After the rest of the field is ploughed, the head-lands themselves are ploughed and turned into ridges.

“ In the following diagram, fig. 21, representing a field, let E F, G H, represent the lines of the head-lands, drawn parallel to A B, and C D, the sides or boundaries of the field, and at the distance from each of these sides of eighteen feet. These lines the ploughman marks out, by running a straight furrow with his plough parallel to the two sides.

Fig. 21.



“ Let him now, beginning at the two sides of the field, *A D*, parallel to which it is intended to run the ridges, measure off with his pole *E a*, seven and a half feet. At the point *a*, let him place one of his poles. This is the point at which he is to *enter* his plough. But, leaving his horses in the mean time, let him walk on to a convenient distance, as to *I*, and then in like manner measuring off *I b*, seven and a half feet, let him set up his second pole at *b*, and then, at the further end of the field, on the line of the head-land, at *c*, let him place his third pole. He has now three poles placed in a line; but if, from the length of the field, or irregularities of the surface, more than three poles are necessary, more must be used, as there must be so many poles in sight, that the ploughman may be enabled to direct his plough, by means of them, in a straight line. He now returns to his plough, and enters it at the first pole at *a*, keeping the other two poles in a line, so that he may be enabled to plough directly towards them. Having entered his plough at *a*, he stops his horses and measures off fifteen feet to *d*, where he plants the pole. He then returns to his plough, which is standing at *a*, and drives his horses, keeping the two poles before him as a guide, to the second pole, *b*. Having done this, and leaving his plough standing at *b*, he measures off from *b* to *e*, fifteen feet, and there he plants his pole. He then returns to his plough, and proceeds forward, making his furrow in a straight line to the last pole at *c*, where in like manner he stops his horses, and measuring off fifteen feet, he plants his pole at *f*.

“ In this manner he has placed his poles in a straight line, at the distance of fifteen feet from the last position, and parallel, as before, to the line of fence. He now turns his horses short about, and returns by the furrow he has just drawn, *c b a*. By this second ploughing he throws the earth out in an opposite direction, so that he has formed a completely open furrow. In returning, he takes care to correct any irregularity or crookedness which may have taken place through the unsteady motion of the horses in his first track.

“ The poles being now placed in a line *d e f*, he brings

his plough to *d*, enters it, and stops it there. He measures off fifteen feet from *d* to *g*, and fixes his pole at *g*; and then he proceeds with his plough to *e* and *f*, repeating the same operation with the poles as before, and returning by the track of the last-made furrow from *f* to *d*. In this manner he proceeds throughout the whole field, forming open parallel furrows, at the distance from each other of fifteen feet; these furrows are to form the *centres* of the future ridges.

“The field is now prepared for being ploughed into ridges, and the manner of doing so is this:—

“The ploughman, beginning at the left-hand side of the open furrow, ploughs his first furrow-slice towards it. He then, returning by the opposite side, performs the same operation, causing the two first furrow-slices to rest upon each other.

“Thus, in forming his first ridge, he begins at the side of *a*, and ploughing in the direction of *a* to *c*, he turns his first furrow-slice into the open furrow *a c*. When he arrives at *c*, he turns his plough right about; and returning from *c* to *a*, he lays his second furrow-slice upon the first one, as at *C*, fig. 21.

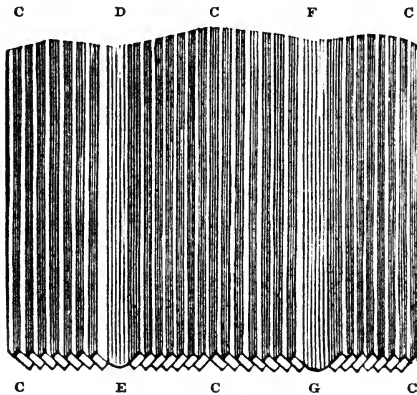
“In this manner he continues, always turning to the right-hand side, and laying his furrow-slices towards the centre of the ridge, until he has reached the boundary of the ridge, *E H*, on the one side, and the line *o s*, half way between *c a* and *d f*, on the other. He has thus formed a ridge, of which *c a* is the crown or centre, and *H E* and *o s* the termination. By proceeding in this manner throughout the field, the whole is formed into ridges, of which the first-marked furrows are the centres.

“It has been said that the ploughman continues turning his horses to the right, and that thus, having proceeded from *a* to *c*, he returns from *c* to *a*, and so on, always ploughing round *a c* as a central line. When, however, he has proceeded from *a* to *c*, he may turn his horses left about, and return from *f* to *d*, and so on, always laying his furrow-slices towards *a c* and *f d*, respectively. In this manner he will have ploughed the half of two adjoining ridges, and terminated at the space *o s*, half

way between them. This method of ploughing, it will appear, has the same effect as turning the horses right about, and is the most frequent and convenient in practice.

“In the following figure, 22, in which C C, C C, C C are the centres of the ridges, the manner in which the successive furrow-slices have been laid upon each other is shown.

Fig. 22.



“By this laying of the earth towards the centres, the ridges acquire a certain curvature. By ploughing the earth away from the intervals D E, F G, the ground is hollowed at these parts, which now forms the *open furrows*. It is by these open furrows that the water which falls upon the surface finds a passage.

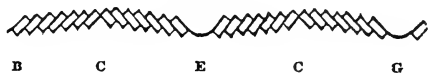
“A certain, though not a great, degree of curvature, is given to the ridge by this ploughing. It is frequently, however, necessary to give it a yet greater degree of curvature and elevation. This is done by ploughing the whole ridge a second time, and in a similar manner.

“The plough is first driven along the centre of the ridge from C to C, forming an open furrow. Successive furrow-slices are then laid towards this furrow, in the same manner as in the previous ploughing. This is done

with the successive furrow-slices, until the plough reaches the open furrows D E, F G. In this manner the whole ridge is ploughed, and an increased elevation and curvature given to it. This operation is termed *gathering*.

“ In performing the operation of gathering, it is important that the ridge be formed with a uniform curvature, so that it shall not have what is technically termed a shoulder, or hollow part, on each side of the crown. It is to prevent this defect, that the open track is made along the crown before the first two slices are laid together; by which means the ploughman is better enabled to lay them upon each other in such a manner that they shall not overlap and form a protuberance at the crown of the ridge. A transverse section of the ridges, when gathered, will appear thus :—

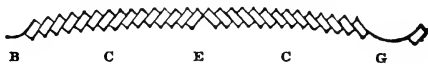
Fig. 23.



“ A ridge, however, being already formed, it may be wished to plough it again, and yet to preserve it at the same curvature and elevation. In this case, the plough is to enter at the open furrow, and to lay the successive furrow-slices towards it, until the two adjoining ridges are ploughed. By this means all the slices of the same ridge lie in the same direction, and the curvature and elevation of the whole remain as before. This operation is termed *casting*, and the manner in which the furrow-slices rest upon each other will appear in fig. 23.

“ In the same operation of casting, two methods may be pursued. The two first furrow-slices, as those at E and C, may be laid resting upon each other, as in fig. 24, in which case the two ridges will be formed, as it

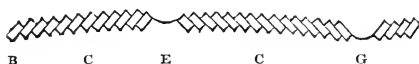
Fig. 24.



were, into one large ridge; or else, the open furrow at E may be preserved by keeping the two first furrow-slices

at a little distance from each other, and preserving the space between them, as in fig. 25.

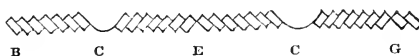
Fig. 25.



“ When land is ploughed in this manner, the ground is taken from one side of each two adjoining ridges at G, and laid towards the other, E ; that is, it is gathered towards one side and gathered from the other. In this manner the ground at the open furrow G, from which we gather, becomes more bare of earth than the open furrow E, towards which we gather. This is an imperfection unavoidable in casting a ridge. When, therefore, we wish to cast a ridge twice in succession, we reverse the former mode of ploughing ; we gather towards the open furrow G, and from the open furrow E, and thus the ridge is restored to its former state.

“ Another method of ploughing is *cleaving*. In this case, the plough commences at the open furrow, lays the first slice towards it, and then, returning by the other side of the open furrow, lays the second slice upon the first, as in fig. 26. When it has reached the centre, it stops

Fig. 26.

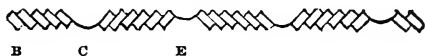


and begins with another pair of ridges, and ploughs the half of each pair together in the same manner. In this way the open furrows of the ridges become the centres, and the former centres become the open furrows. The operation of cleaving is of constant occurrence in the summer-fallow, and other cleaving processes of tillage. When we wish to level a ridge, we cleave it.

“ There are two variations to be noticed in the practice of cleaving : either the two first slices are laid together, in which case the open furrows of the former ridges become the centres, and the former centres the open furrows, in the manner shown in fig. 26 ; or a certain

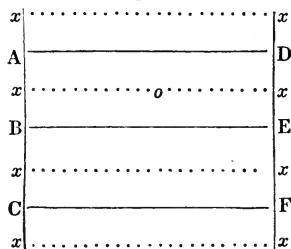
distance is kept between the two first slices, and so the open furrow is preserved. In this case, each ridge is split into two ridges, and the number of open furrows is doubled. See fig. 27.

Fig. 27.



“The next method of ploughing is *cross-ploughing*. This, as the name denotes, is ploughing in a direction crossing that of the former ridges and furrows.

Fig. 28.



“In cross-ploughing, the workmen place themselves at equal distances from each other, as thirty or forty yards, at the side of the field at which they are to begin to plough. Each then runs a straight furrow across the field, as, fig. 28, from A to D, from B to E, from C to F. Each then returns as from D to A, from E to B, from F to C, laying always the successive furrow-slices towards the right hand, until each man arrives at the termination of his allotted space, *xx, xx, xx, xx*. There has been thus formed by each workman one great ridge, but so extended that it may be said to be without curvature. The ploughmen, we perceive, turn from left to right around the first furrows, A D, B E, C F. But they may also turn from right to left. Thus, in going from B to E, the ploughman lays his first furrow-slice to the right hand. When he arrives at E, he may turn his horses left about, and proceed to D, and returning from D to A, lay his first furrow-slice to the right hand towards D A. Turning left

about when at A, he proceeds in the direction B E, and so on, always turning left about, until he has arrived at the middle space *o*, when the whole space A D and B E will have been ploughed.

“ Sometimes, for convenience, and the saving of distance, he may plough in the first place round the central line B E, by turning from left to right, and then plough the remainder of the interval by turning from right to left.

“ These are matters of detail somewhat difficult to be described clearly, but so simple in themselves that they need only to be seen in the field, to be thoroughly understood.

“ The first operation, we have seen, is, striking the furrows previous to forming the ridges. This is done by laying off, by means of furrows, first the lines of the headlands, and then the parallel lines corresponding to the future centres of the ridges to be formed.

“ The next operation is forming the ridges. This is done by beginning at the centre, and ploughing towards it, until each ridge is formed.

“ When ridges are formed, they may subsequently be ploughed in different ways.

“ *First*, they may be gathered ; in which case, beginning at the crown, the ridge is ploughed, and an increased elevation given to it.

“ *Second*, they may be cast ; in which case, two ridges are ploughed together, and either formed into one large ridge, or, by keeping the open furrows clear, retained in two ridges.

“ *Third*, they may be cloven ; in which case, beginning at the open furrows, the half of each adjoining ridge is laid together. The first two furrow-slices may either be laid close together, or the open furrow may be kept clear between them. In the first case, each ridge will have been so cloven, that the open furrow shall have become the crown, and the crown the open furrow. In the second, each ridge will have been cloven into two, and the number of ridges and open furrows doubled.

“ In the original laying out of the ridges, the lines have been described as running straight through the field ;



but it is frequently expedient, on account of the irregularities of the surface or other causes, to change the direction of the ridges at some part of the field, so as to facilitate the discharge of the water.

“ The application to this case of the principle of striking the furrow is easy. The ploughman makes a furrow where the change of direction is to take place, straight or curved, as circumstances may require. The one set of ridges terminate at this part, and the others are laid off from it in the new direction to be given. The ploughman, by means of his poles, as before, strikes his first set of furrows, terminating them at the furrow where the change of direction is to take place. From this furrow he strikes his second set of furrows in the direction in which they are to run. The part where the opposite set of furrows meet, may be made an open furrow, or a raised-up ridge, or head-land, as circumstances may require.

“ The direction of the ridges must generally be regulated by the sloping of the fields, and the lying of ditches and fences, so that they may promote the main purpose for which they are formed, the carrying off of surface-water. But, other circumstances being alike, they should be made to lie as much as possible north and south, and as rarely as possible east and west ; for, in the latter case, when the ridges are much elevated, the north side has a somewhat less favorable exposure than the south side.

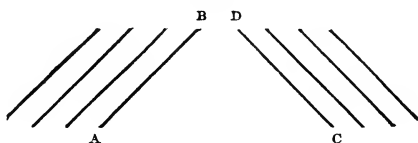
“ Sometimes ridges are altogether dispensed with, either where the land is very dry, or where it is wished to keep it in grass, and give it the aspect of a park or lawn. In this case, the ploughs may either follow each other round the entire field, and terminate at the centre, or they may plough in large divisions, as in the case of cross-ploughing.

“ In ploughing very steep land, it is frequently laid in ridges diagonally across the slope, for the purpose of rendering the labor more easy, and of lessening the danger of torrents carrying away the surface.

“ The precaution to be observed in this case is, to make the ridges slope upwards from the right hand, as from A to B, fig. 29, and not from the left hand, as from C to D. For in the first case, when the laboring

cattle are ascending the steep, the plough is throwing the furrow-slice down hill ; whereas, in the other case, when the cattle are ascending, they are raising the furrow-slice up hill, by which their labor is greatly increased.

Fig. 29.



“ Besides the open furrows of the ridges, which act as channels for carrying off the water, it is necessary, when there are hollow places where water may stagnate, to form open furrows or channels. This is done by drawing a furrow with the plough in the direction most convenient for the purpose. A workman then follows with a spade or shovel, and carefully opens intersections with other furrows, so that there may be a free communication between them.

“ Sometimes it is necessary that the furrow made by the plough be further deepened by the spade, so as to form a channel sufficiently large ; and wherever head-lands intersect the run of water, channels must be cut through them to the ditch or outlet, so that none may stagnate upon the ground. Attention to these details in practice is essential in all cases of tillage ; and it manifests a want of skill and industrious habits in the farmer to suffer his lands to be unproductive by the stagnating upon them of surface-water.”—*Professor Low's Elements of Practical Agriculture.*

It has been ascertained, that a team, walking at the rate of one and a half miles an hour, will plough the following quantity of a medium soil, to the depth of five inches, in nine hours :

				<i>A.</i>	<i>R.</i>	<i>P.</i>
Breadth of furrow	8 inches,	at	$1\frac{1}{2}$ an hour,	1	0	00
“	9	“	“	“	1	0 20
“	8	“	2	“	1	1 10
“	9	“	“	“	1	2 00

The difference in the quantity ploughed in these instances clearly demonstrates the value of action in horses ; but it must at the same time be observed, that the distance travelled at the slow pace is only twelve, while at the quicker rate it is sixteen miles.

We will close the subject of ploughing, with the following

### § 2. *Rules for Ploughmen.*

1st. The horses should be harnessed as near to the plough as they can be placed without impeding the freedom of their step ; for the closer they are to the point of draught, the less exertion will be required to overcome the resistance.

2d. When ploughing with a pair abreast, the most powerful horse should be worked in the furrow ; but if the team be harnessed in line, and there be any difference in the height of the cattle, the tallest should be put foremost, if he be in every respect equal to the other.

3d. When at work, they should be kept going at as regular and good a pace as the nature of the work will permit ; for they are thus more manageable, and the draught easier than when slow. By due attention to this, the heavy soil will cling less to the coulter, and the land will be found to work more freely.

4th. The breadth and depth of the furrow being ascertained, the plough should be held upright, bearing equally all along on a straight sole, and be made to move forward in a regular line, without swerving to either side. The edge of the coulter should be set directly forward, so that the land-side of it may run in a parallel line with the land-side of the head, and in such a position that their slant or sweep may exactly correspond.

5th. The ploughman should walk with his body as nearly as possible upright, without leaning on the stilts, and without using force to any part, further than may be absolutely necessary to keep the implement steadily in a straight line. He should also be sparing of his voice, and of correction to the team : of the former, because too much cheering and ordering only confuses the cattle ;

and of the latter, because punishment, when often repeated, at length ceases to have due effect, and thus leads to unnecessary beating.

There is, in fact, a certain degree of taste in ploughing, as well as in every thing else,—a kind of tact, which is difficult to be taught, and hardly to be acquired except by a sort of instinct. The ploughman who tills the ground with dexterity, never presses upon the plough without necessity. A mere touch, or a glance of the eye, tells him when she is going wrong, and a slight turn of the hand sets her instantly right; whereas a clumsy fellow, without feeling in his palms, or readiness or perception, is continually either throwing the plough out, or she is riding upon the heel or point, straining the team, tiring himself, and altogether making bad work.

There are various modes of regulating *the pitch of the plough*. Thus, it may be made to go deeper by lowering the back-bands, or increasing the distance of the team; by setting the muzzle higher up in the index of the beam, and by slanting and giving the coulter a greater rake forward; and the reverse will make it go shallower. It can also be constructed with a regulating lever, which may be attached to any of the foot and wheel ploughs now in use, and can be used occasionally, or otherwise, as circumstances may require. The side motion may be thus altered so as to make the plough take a broader slice, or, as it is commonly called, “to give her more or less land:” by putting the hook of the traces into the notches of the muzzle more towards the unploughed ground, *you take land from the plough*; but by shifting it to the furrow side, *you give it land*. It ought, therefore, to be made about eight inches in length, and may

Fig. 30.

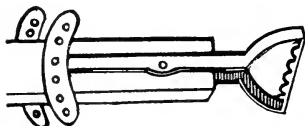
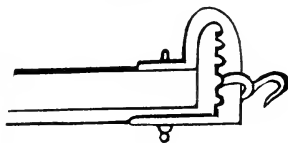


Fig. 31.

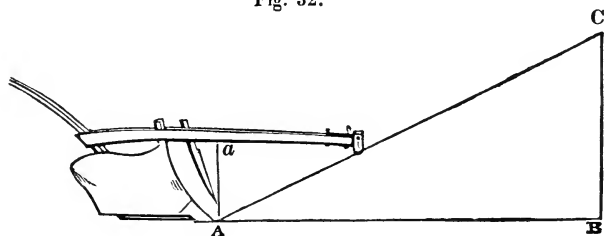


be fixed either to the side of the beam, or to the top and bottom, as delineated in figs. 30 and 31.

The ploughman may also give greater breadth by pressing the stilts towards the right; though it is a bad plan, and requires too much exertion to be continued throughout a day's work.

On the *subject of draught*, it may be observed, that when horses are properly harnessed to the plough, their traces will be in a direct line, from the point of draught at the shoulder, to the point of the share, passing through the regulating notch of the muzzle. It is proper, therefore, to ascertain the animal's height, in order that the muzzle may be fixed accordingly; but as his shoulder is not so far from the ground when he is pulling, as when he is in a state of rest, an allowance must be made for the difference. Thus, if a line be drawn from A, at the share of the plough, to B, fig. 32, and then a perpendicu-

Fig. 32.



lar line from B to C, at the horse's shoulder, an angle is formed; then if another perpendicular line be formed from A to a, and measured upon the same scale, it will give the height of the beam from the ground, at the depth to which it is to be ploughed.

It follows, therefore, that the more the beam is raised in height, the longer it must be made, and consequently the traces of horses must be lengthened: this, however, lessens their power; for it is sufficiently well known, without entering into any mathematical proof upon the subject, that the further the animal is placed from his work, the less effectual will be his exertions. The Reverend Mr. Priest made this experiment, with a furrow

9½ inches wide and 3¾ deep; when the length of the horses' traces was 10 feet 5 inches from the point of the share to the point upon their shoulders upon whence they were drawing, the force exerted upon the point of draught of the plough, or the power of their draught, was only 2¼ cwt.; but when the traces were lengthened to 15 feet 6 inches, the force exerted to draw the plough was 3½ cwt.—See *British Husbandry*.

### § 3. *The Harrow.*

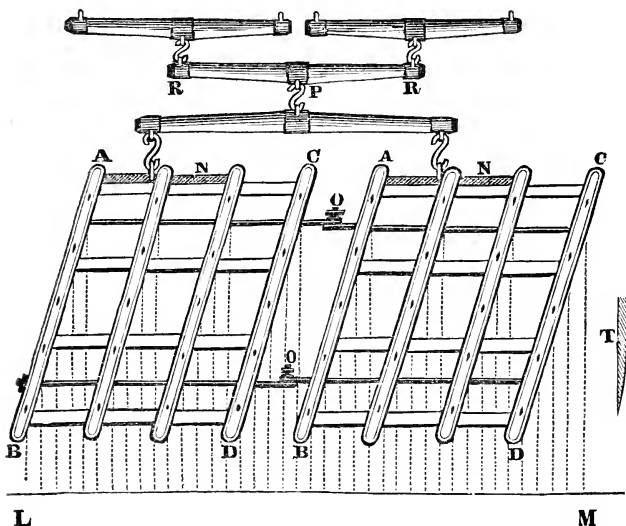
The uses of the Harrow are, 1st, to pulverize the soil; 2d, to clean the ground of the roots of foul plants, as dock, quack, &c.; and, 3d, to cover the seed. The triangular drag, with stout iron teeth, which is well adapted to new lands, has been principally in use until a recent period; but we are now having them of various patterns, and adapted to different soils and different purposes. Upon new lands, and upon heavy clay soils, a strong, heavy harrow is to be preferred, particularly in preparing the ground for seed. A light harrow would not do for either of these purposes,—it would neither tear up the new soil, nor pulverize the stiff one. Upon lands already under culture, or not stiff, square or angular harrows are preferred; while upon well-worked farms of light soil, lighter jointed harrows, with smaller and closer-set teeth, and frames that will conform to inequalities of surface, are best, and are in all cases preferable for seed-harrows. A farmer, therefore, who makes pretensions to good management, ought to have at least one heavy harrow to pulverize the soil, and another and a different one to cover his seeds.

In using the harrow, the teamster should understand the object, and take care to accomplish it. If it be to break down and mellow the soil, this should be done, though it may require one, two, or three bouts. If it be an object to eradicate the roots of perennial weeds, these should be carefully collected, as they are thrown to the surface, and carried off; and if the harrow is applied to cover seeds, every particle of the surface should be gone over, both ways of the field, and a smooth-

ness and evenness of the surface effected as far as practicable.

In regard to the shape of the teeth, they should be square, with a gradual taper to the point, the fore part being kept straight, as in T, fig. 33. The teeth should

Fig. 33.



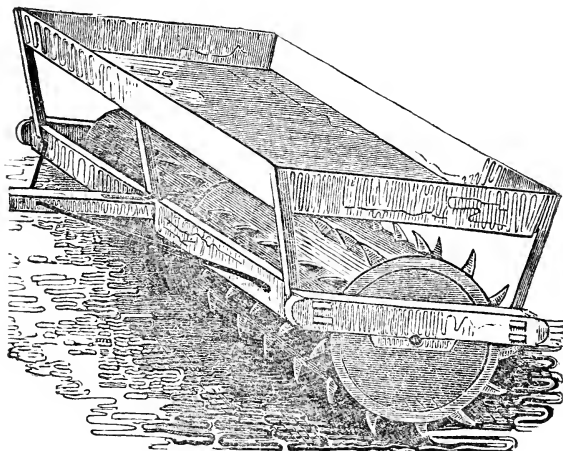
not be placed too closely together, for then they would be too much impeded by the obstacles opposed to them : they should be so disposed and drawn, that one tooth shall not cut in the track of another, and that one part of the instrument shall not be more interrupted than another : their number should not be too great, because their power to penetrate into the ground will be diminished, unless the weight of the harrow is considerably increased : and, lastly, they should not be longer than necessary, because an unnecessary length will expose them to greater obstructions, and render them more liable to split the frames in which they are fixed.

Harrowing is best performed when the land is dry,

because the soil is then better pulverized, and less poached by the feet of the cattle.

The harrow is often employed upon winter grain, in the spring, and to manifest advantage. A light one is best for this purpose, as the object is merely to break and pulverize the surface. It is also employed, and here is a heavy one wanted, to scarify old meadow and pasture grounds, to extirpate moss, and to cover the seeds of grasses which may be sown to renovate them. For the latter purpose, as also for pulverizing stiff clays, Concklin's press-harrow, fig. 34, is an admirable instrument.

Fig. 34.



The harrows represented in fig. 33 are of the most approved construction, for light soils and for seeds. The frame is wood and the teeth are iron.

“ They are connected together in pairs by hinges. They consist each of four bars of wood, A B, C D, &c., which are joined together by an equal number of cross-bars of smaller dimensions, mortised through them. The larger bars may be  $2\frac{1}{2}$  inches or more in width, by 3 in depth, and the smaller  $2\frac{1}{4}$  inches in width, by 1 in depth. The larger bars are placed oblique to the smaller



bars, and to the line of the harrow's motion, and the teeth are inserted into them at equal distances from each other. This inclination is made to be such, that perpendiculars falling from each of the teeth upon a line *L M*, drawn at right angles to the harrow's motion, shall divide the space between the bars into equal parts, so that the various teeth, when the instrument is moved forward, shall indent at equal distances the surface of the ground over which they pass.

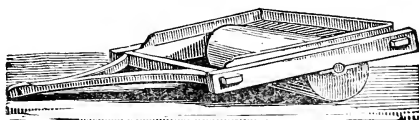
“The number of teeth in each harrow is twenty, five being inserted in each of the larger bars. When two harrows, therefore, are employed together, the surface of the ground from *L* to *M* is indented by 40 teeth, impressing the ground at equal distances from each other, and covering the space of about 9 feet. The teeth may project below the under surface of the frame 7 or 8 inches, their length somewhat increasing from the hindmost to the foremost rows, where the oblique position of the line of draught tends most to elevate the harrow. The teeth are often inserted into the frame with a little inclination forward; but this deviation from the perpendicular, if made at all, should be very slight, because it renders the harrow more apt to be impeded by the weeds or other substances collecting in the angle between them and the frame. The teeth are fixed in the bars by boring holes with an auger of about  $\frac{3}{4}$  of an inch in diameter, and then drawing them firmly through. The teeth, when thus driven into the bars, will be retained with sufficient firmness. The best of the common kinds of wood for the larger bars, as being least liable to split, are elm, beach, or ash, and for the cross-bars ash.

“The iron rods which terminate in the hinges, *O, O*, may pass through the frame-work, to give it greater strength. These rods keep the harrows at the distance required, and the hinges admit of either harrow rising or falling according to the inequalities of the surface. When thus joined, the harrows are drawn by two horses guided by reins, the driver walking behind, so as to be prepared to lift up either harrow when choked by weeds, or otherwise interrupted.

§ 4. *The Roller.*

The roller is made of iron, stone, or wood, according to convenience, or for the purposes for which it was intended. In American husbandry, we have no reason to expect, or perhaps desire, any but such as are made of wood, and such as any farmer, who has a moderate degree of mechanical skill, and the carpenters' tools which every farmer ought to keep, may readily construct. A sound oak log, with the frame and shafts or tongue appended, will make a good roller. Rollers are made of different lengths and sizes, varying from 15 to 30 inches in diameter, their length from five to ten feet, and their weight should be from 12 to 20 cwt.—the heavier soils requiring the heavier, and the lighter soils the lighter one. The weight can readily be increased by stones, or other heavy substances, deposited in a box to be placed upon a frame. The lighter kinds are made in one piece; but the larger and heavier kinds are made in two pieces, with a washer between them, and an iron rod passing through the centre of both, which forms the axis upon which they revolve. English farmers construct on the model indicated in fig. 35, upon the frame of which a box may be attached, either

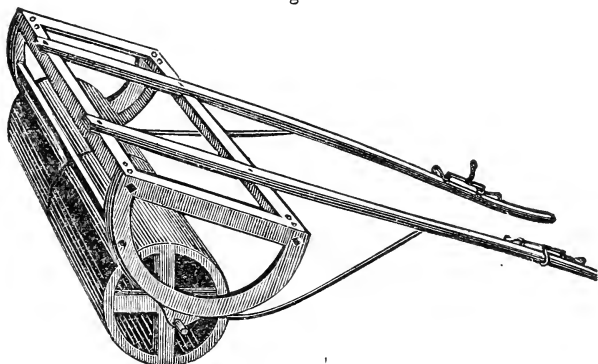
Fig. 35.



to contain stones to add to the pressure of the roller, or to receive small stones and rubbish, gathered by the teamster as he progresses, and which are to be carried off. The objection to the English roller is, that the power is not advantageously applied. We think the model delineated in fig. 36, and which is the kind generally used in the United States, is preferable to the other, because the draught is nearly in a right line from the point of draught at the collar or yoke, to the point of resistance. This may be done and the advantages of the box retained. It is stated by Low, that, comparing together two rollers with cylinders

of unequal diameter, that with the larger cylinder will be more efficacious than that with the smaller cylinder, because a greater weight can be brought, by the exertion of the same force, to act upon the ground.

Fig. 36.



The uses and advantages of the roller are many and important. It is particularly serviceable in the seeding process, to break down the clods, pulverize and smooth the surface, and to press the earth to the smaller seeds, which otherwise often fail to germinate for lack of moisture. This is particularly the case with oats, barley, and grass-seeds. In autumn, the roller is sometimes passed over winter grain, with the view of counteracting the injurious effects of frost the following winter. In spring, it is advantageously drawn over winter grain, as soon as the ground is so solid and dry as to bear the tread of the cattle without poaching it. It renders light ground more compact, presses the soil to the roots of the grain, and thus promotes its growth; and upon all soils it closes the innumerable cracks and fissures which abound upon the occurrence of dry weather in spring, occasioned by the abstraction of moisture and the consequent contraction of the soil,—and, by partially burying the crown, causes grain to tiller better, that is, to send up more seed-stocks.

Finally, a heavy roller is of great advantage to grass-grounds in the spring, by reducing irregularities of surface, and pressing down the plants or earth which have been thrown up by the frost.

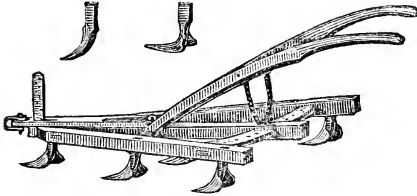
There are also rollers constructed for other purposes, as the *spiked roller*, which is used to pulverize stubborn clays preparatory to the wheat crop, and to scarify old meadows and pastures, as a means of renovating them, and of covering the seeds of grasses which may be sown thereon. Of this description is *Concklin's press-harrow*, fig. 34, and a somewhat similar implement invented at Washington. The common spiked roller is formed by inserting several rows of spikes, of cast or wrought iron, in a common hardwood roller. The *concave*, or *scalloped roller*, is adapted to the form of ridges, and a small one is often attached to the horse turnip-drill.

#### § 5. *The Cultivator.*

There are now various implements in use denominated Cultivators, similar in their use, and frequently resembling, in their construction, the horse-hoes of Europe. They are particularly serviceable in the culture of Indian corn, Swedish turnips, beans, and other row and drilled crops, as a substitute for the plough. By passing this implement frequently between the rows, the ground is kept free from weeds, and in a fine state of pulverization, while the manure and vegetable matter of the sod, which have been buried by the plough in preparing for the crop, are left below, where they are most efficacious, and the roots of the plants are preserved from injury. The cultivator should be passed through a hoed crop twice at a dressing, and if the soil be stiff or grassy, it may be passed oftener, or repeated at short intervals. The teeth are of various forms, according to the purpose for which they are used. One of these forms is shown in fig. 37. It is most convenient to have teeth of different kinds, for instance, such as are fitted to skim the surface, and destroy weeds—others to break up and pulverize the surface; and others, again, to gather the roots of quack and other perennial pests. One of our neighbors has been

enabled completely to eradicate quack-grass in his Indian corn, by the frequent use of this implement. The dif-

Fig. 37.

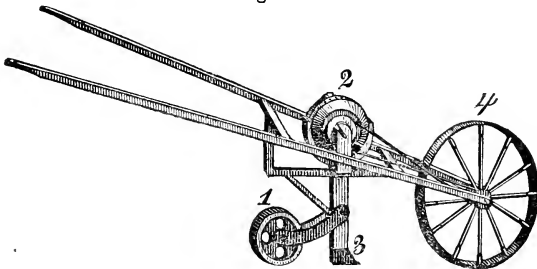


ferent kinds of teeth may be adapted to the same frame, and fastened with nuts or wedges, and shifted in a few moments. The frames are generally made to contract or expand at pleasure, so that the implement may be graduated to different breadths. They are generally drawn by one horse.

#### § 6. *The Drill Barrow.*

Drills are used exclusively for sowing seeds, and are various in their construction. They are propelled by manual and by horse power. The former are denominated drill barrows, and are generally adapted to sowing single rows. They are of recent introduction in American husbandry, and their use is principally confined to sow-

Fig. 38.



ing turnips, beets, &c.; and some of them, under the name of corn-planters, are employed in planting Indian

corn. They are an economical implement upon the farm, and are particularly so where root culture has obtained a deserved footing.

Drills drawn by horses, and sowing ten or a dozen rows at a bout, are used to a considerable extent in Great Britain ; and those most familiar with their use, claim for this culture great advantages over the broadcast system. The drill system enables the cultivator to keep his grounds clean, and insures an augmentation of product.

Fig. 39.

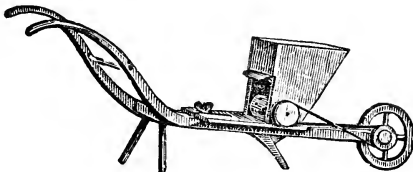


Fig. 38 is a delineation of Bement's, and fig. 39 of an ordinary drill barrow.

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## CHAPTER XV.

### ALTERNATION OF CROPS.

ALTERNATING crops, is to grow crops of different kinds, and, as far as practicable, of different habits, successively in the same field, as grain, roots, and grass. It is an essential requisite in good farming, and forms a part of it, wherever the soil will admit of it, and wherever farming has arrived at any degree of perfection. It is this which gave to Flemish husbandry a pre-eminence over that of every other country, long before the new system had obtained a footing in Great Britain. The Flemings insist, that land does not require rest where this principle is adhered to ; and we think it is Radcliffe who states, that he saw the operations of harvesting the grain crop, ploughing, and sowing turnips, going on in the same

field simultaneously—the ground being broken up and sowed as fast as the corn was cut and removed. In this way they often get two crops in a season, and very frequently three in two years. It is by alternating crops, that the county of Norfolk, and other sandy districts in England, once poor and unproductive, have been converted into the most wealthy and populous portions of that country. It is this alternating system which has contributed, in a great measure, to the astonishing recent improvements in the agriculture of Scotland—on many farms none of the fields being kept in either meadow or pasture more than two years in succession. And it is this system which constitutes the pioneer-marks of improved husbandry in our own land.

In the preceding essays, we have suggested the importance and the modes of making our lands rich and dry, and of subjecting them to good tillage. Let us now inquire under what method of management they are likely to make us the largest returns, without diminishing their intrinsic value.

It must be palpable to every observing farmer, that the old mode of dividing our farms into meadow, plough, and pasture lands, and of permanently using each section for one purpose only, is a most wretched system of exhaustion, both to the land and its occupant. The tillage ground deteriorates, with the scanty manuring it gets, till it ceases to make a return for the expense of culture, or till it is thrown into old fields or commons. The grasses run out in the meadow, and mosses and perennial weeds come in; the soil becomes too compact and impervious for the ready admission of the great agents of vegetable decomposition and nutrition, heat and air, and the free extension of the roots of the finer grasses;—and, as all is carried off, and little or nothing brought back, the elements of fertility become exhausted, the land annually becomes poorer, and the crops grow every year lighter. Nothing but a triennial top-dressing of manure or compost will keep up the fertility of perennial meadows; and these fertilizing substances can seldom be spared from the arable part, to which they may be applied with more certain

profit. The pasture is the only portion of such a farm that is improving ; and, even in this, bushes, brambles, and noxious weeds are too often permitted to intrude, to choke and destroy the better herbage.

It is equally apparent, that we cannot take two or more arable crops, of the same kind, from a field, in successive seasons, without a manifest falling off in the product. The reason of this may be found in an immutable law of Nature, which has provided for each species of plant a specific food, suited to its organization and its wants. Thus some soils will not grow wheat, although abounding in the common elements of fertility, and although they will make a profitable return in other farm-crops—in consequence of such soils being deficient in the specific food required for the perfection of the wheat. The same remark applies to other farm-crops. One family or species of plants requires a different food from that which another family or species requires ; and it seems to be another law of Nature, that what is not essential to one family, or species, shall be left in the soil, or returned to it through the excretory organs of the growing crop. Of course, the specific food for any class, or species, continues to accumulate in the soil, the general fertility being kept up, till the return again to the field of this particular crop. Thus it is supposed to require ten or a dozen years for the specific food of flax sufficiently to accumulate for a second crop, after one has been taken from a field. Even the specific food of clover becomes exhausted by a too frequent repetition of it in the same field ; it being found necessary, in Norfolk husbandry, to substitute for it, in every other four years' course of crops, other grass-seeds, so that this may not be repeated oftener than once in eight years. In the analysis of plants, wheat is found to contain lime, the turnip to contain sulphur, &c., and hence we infer that these elementary matters are essential, in the soil, to the growth of these crops.

There are exceptions to the rules of practice which these laws inculcate. Some soils seem natural to wheat, others to oats, timothy, &c., and successive crops of these are taken without apparent diminution of produce.



Yet it is better to regulate our practice by general laws, than by casual exceptions. In the cases noted as exceptions, there is probably so great an accumulation of the specific food of the particular crop, that it has not been *exhausted*, though it evidently must have been *diminished*. It is in accordance with the natural laws we have noticed, that the grasses in our meadows run out or change; that the timber-trees of the forest alternate—new species springing up as the old ones decay, or are cut off; and it is in accordance with these laws that the alternation of crops has been adopted in all good farming.

To simplify and render the subject more plain, the generality of tillage crops have been grouped into two classes, differing essentially in their character, culture, and influence upon the soil. These two classes are denominated *culmiferous* crops, and *leguminous* crops. The first is so named from *culm*, the stock or stem of grains or grasses, usually jointed and hollow, and supporting the leaves and fructification. Our intention is here not to include the grasses. Culmiferous crops are termed robbers or exhausters of the soil. This class includes wheat, barley, oats, rye, Indian corn, tobacco, cotton, &c. These are particularly exhausting during the process of maturing their seeds. If cut green, or when in blossom, they are far less exhausting. Leguminous crops, strictly, are peas, beans, and other pulse; but here the group is intended to embrace, besides, all that are considered ameliorating or enriching crops, as potatoes, turnips, carrots, beets, cabbages, and clover. These last are not only less exhausting than the culmiferous class, as but few of them mature their seeds, and all, on account of their broad system of leaves, draw more nourishment from the atmosphere than the narrow-leaved plants of the other class, but they tend to improve the condition of the soil, by dividing and loosening it, with their tap and bulbous roots. For these reasons they are called ameliorating crops; and as they generally receive manure, and are cultivated with the horse or hand-hoe, they are peculiarly adapted to fit the soil for the culmiferous group of crops.

There is another distinguishing feature between the culmiferous and leguminous classes we have named—the form of their roots. The first are generally fibrous-rooted, are more divided, spread themselves near the surface, and draw their nourishment principally from the upper stratum of the soil. The leguminous group are generally spindle or tap-rooted, with few radicles, and consequently draw most of their nourishment from the lower stratum of the soil, and through the lower extremities of their roots. Plants, says Chaptal, exhaust only that portion of the soil which comes in contact with their roots; and a spindle root may be able to draw an abundance of nourishment from land, the surface of which has been exhausted by short or creeping roots. The roots of plants of the same or analogous species, continues the same writer, always take a like direction, if situated in a soil which allows them a free developement; and thus they pass through, and are supported by, the same layers of earth. For this reason we seldom find trees prosper that take the place of others of the same species, unless a suitable period has been allowed for producing the decomposition of the roots of the first, and thus supplying the earth with fresh manure.

Good husbandry, therefore, enjoins, that culmiferous and leguminous crops should follow each other in succession, except where grass is made to intervene; and it matters little what crops are selected from the two classes. The good judgement of the farmer may be here exercised to determine which are likely to be to him the most advantageous. It may be proper to note two exceptions to this rule: Indian corn may, under certain contingencies, be made to follow a small-grain crop to advantage, and oats may be sometimes sown, as a fallow crop, upon a grass ley; as a fallow crop to precede wheat or rye, and to supersede a naked fallow. Some soils, it is true, are better suited to one kind of crop than another; as, for instance, calcareous clays, and strong loams, are better adapted to wheat than silicious gravels and sands; while the latter are better fitted to Indian corn, turnips, clover, and other tap-rooted plants, than clays. And where In-

dian corn is to succeed small grains, we venture to recommend the sowing of clover with the small-grain crop. It far more than compensates, to the corn crop, the expense of seed and sowing, and gives, withal, much autumn pasture. In other respects, such as the exhaustion of the soil, it is a matter of little interest with the farmer, what crops of each class are chosen to alternate with each other.

Farm-stock seems necessarily to be embraced in the system of alternate husbandry. Cattle convert the bulky products of the farm into meat, butter, cheese, wool, &c. These concentrated products are carried to market at comparatively trifling expense. Cattle, which furnish labor, and convert into manure the stalks, straw, coarse hay, and other offal litter of the farm, are necessary to keep up its fertility; for without manure the soil will grow poor, and its products annually diminish. Manures, we repeat, are a main source of fertility and of wealth,—they are the substantial food of our crops. Lime, and gypsum, and other extraneous matters, are good as auxiliaries, but none of these can be depended on, as means of fertility, without the efficient aid of dung. This is the bread—the “staff of life,” to our farm-crops. Our supply of this essential requisite will depend on the amount of stock we feed upon the farm; and the amount of stock we can keep profitably, will again depend upon the fertility of the soil, and the abundance of its products. So that grain, and grass, and root, and cattle husbandry, are reciprocally and highly beneficial to each other. It is maintained, by practical men, that grounds under good tillage will yield as much cattle-food, in roots, straw, &c., as the same grounds would yield in grass, thus leaving the grain as extra profit.

The subject of clover, which we have classed with ameliorating crops, merits a further and distinct notice.

We find that clover was cultivated at an early period by the Flemings, and constituted an important item in their excellent system of husbandry. Its introduction into British husbandry is of comparatively modern date.

Forty years ago its culture may be said to have commenced in the United States ; but its progress was slow till within the last few years ; and even now, the farmers of large portions of our country are practically ignorant of its improving and enriching qualities. Its benefits have been great wherever it has been introduced, accompanied with the use of gypsum ; and the two combined have done much to improve our husbandry. But their benefits are capable of being much more widely extended.

Clover is less exhausting to the soil than almost any other crop. It derives much nourishment from the atmosphere ; and its tap-roots, penetrating the soil to a great depth, break and pulverize it, and fit it admirably for the reception of tillage crops. We consider the use of clover as cattle-food, great as it is, but of secondary importance to the farmer—its most profitable uses being to feed crops and furnish seed. No green crop is so serviceable as manure ; and the second crop of the early variety may be profitably preserved for seed. We have recorded in the *Cultivator* the practice of Mr. ———, of Tompkins county, who has converted a poor farm into one of great productiveness, almost entirely by the judicious use of clover. He sows the seed liberally, preferring the early or southern variety. This he feeds till the 20th of June, or, if it is to be mown, he cuts it by the 25th of that month. He then leaves it for a second or seed crop ; and after this is off, he generally turns up the ley for a winter or spring crop. Thus the first crop serves to feed his cattle ; the second serves the double purpose of feeding his cattle and filling his purse, for the average product of an acre is four or five bushels of seed, worth ordinarily from thirty to fifty dollars, and the stems are carefully saved, and serve for cattle-food and litter ; while the roots and foliage left upon the field go to fertilize it for the next crop.

We can quote no better authority than Chaptal, a distinguished chemist, and a practical farmer upon a broad scale, in support of the alternating system. He says,

“ Artificial grass lands (constituting a part of the alternating system of husbandry, and in contradistinction to

natural and permanent grass lands) ought now to be considered as forming the basis of agriculture. These furnish fodder, the fodder supports cattle, and the cattle furnish manure, labor, and all the means necessary to a thorough system of cultivation."

In order to show the contrast which exists in the products of farms, under the new and old systems of husbandry, we quote two cases of products under the new system. In neither of these cases were the lands of great natural fertility. The first farm is situated on a sandy pine plain, which until lately was considered of little value for husbandry. Forty years ago these lands sold for three dollars an acre. They now sell at fifty to one hundred dollars an acre. The other farm lies in the neighborhood of Poughkeepsie, and, if we are correct in our recollections, a part of it was in *old field*, or commons, in 1801-2.

Samuel T. Vary's farm lies on the Kinderhook plains. There are 145 acres under cultivation. It was worked in 1835 by Mr. Vary and his sons. His total expenditure, that is, money laid out for his family and farm, amounted to \$385 75. After speaking of the depredations of the wire-worm, early and late frosts, and other drawbacks with which farmers are ever afflicted, Mr. Vary proceeds to give the following statement of the

*Products and Sales of the Farm in 1835.*

12 calves,	\$37 89
196 lbs. butter, at 20 cents,	39 20
1542 " cheese, at 8 cents,	123 36
30 lambs, at 15s.	56 25
850 bushels oats, at 52 cents,	442 00
375 do. potatoes, at 25 cents,	93 75
20 tons hay, at \$15 per ton,	300 00
72 bushels onions, at 50 cents,	36 00
500 do. corn, at 84 cents,	420 00
220 do. wheat, at \$1 50,	330 00
4 cows, beef,	69 00
2 oxen and 2 steers, do.	130 00
7 shoats,	17 00

1440 lbs. pork, at 7 cents, . . . . .	\$100 80
22 wethers, at \$4 each, . . . . .	88 00
Total value, . . . . .	<u>\$2,283 25</u>
Deduct money paid out, . . . . .	385 75

Leaving a balance of . . . . . \$1,897 50

See Cultivator, vol. ii. p. 181.

The other case is that of Mr. David Harris, the details of which are also given in the Cultivator, vol. iii. p. 30. Mr. Harris cultivated 143 acres. He gives the following as the proceeds of his farm in 1835.

190 bushels of wheat, at \$1 25, . . . . .	\$237 50
165 " of rye, at 94 cents, . . . . .	155 10
325 " of corn, at 75 cents, . . . . .	243 75
900 " of oats, at 50 cents, . . . . .	450 00
27 " of buckwheat, at 50 cents, . . . . .	13 50
7 live shoats, . . . . .	40 00
1200 lbs. pork, at 7 cents, . . . . .	84 00
3 calves, . . . . .	9 50
90 tons of hay, at \$22, . . . . .	1,980 00
Advance on 26 sheep, . . . . .	65 00
60 bushels potatoes, at 25 cents, . . . . .	15 00
	<u>\$3,293 35</u>

The amount of sales from the above.

100 bushels of wheat, at \$1 25, . . . . .	\$125 00
165 " of rye, at 94 cents, . . . . .	155 10
209 " of corn, at 78 cents, . . . . .	163 02
700 " of oats, at 50 cents, . . . . .	350 00
7 live hogs, . . . . .	40 00
3 calves, . . . . .	9 50
75 tons of hay, . . . . .	1,762 50
Advance on 26 sheep, . . . . .	65 00
Received for pasture and feed, exclusive of my own stock, . . . . .	60 00
	<u>\$2,730 12</u>
Expenses for labor, &c. on the farm, . . . . .	275 00
Nett profit, . . . . .	<u>\$2,455 12</u>

Thus Mr. Vary's farm afforded him a nett annual profit of about \$13 08 per acre, over and above the amount paid out for his family, and for farm-labor, &c., and Mr. Harris's gave him a nett profit of about \$17 16 per acre, over and above his farm-expenses.

A strong argument in favor of alternating crops may be drawn from the alternations which are naturally going on in forests, and in permanent meadows, and from the habits of many plants, in sending abroad roots and stollens, to establish a progeny in fresh, unexhausted soil. Thus, in forest lands, the new growth seldom resembles altogether that which has been felled. Hard wood frequently succeeds the pine and hemlock, while the pine and cedar, in innumerable instances, succeed the primitive growth of hard wood. The raspberry and the strawberry soon exhaust the soil of specific food, and Nature has endowed these plants with the power of virtually changing their location, by means of roots and stollens, and of annually renewing their vigor from the resources of, to them, a virgin soil. And even the delicate stoloniferous rose is constantly changing its location in this way, and droops and declines, in three or four years, if confined to a single spot. With herbaceous plants which die and decay where they grow, this disposition to change does not exist in so great a degree—because they annually return again to the soil, and furnish the specific food for a new generation of their species. So general is this law of alternation, that it has become a well-settled opinion among British farmers, that even our common biennial clover should not be sown oftener than at intervals of six or eight years upon the same field, its tendency, in common with other plants, being to exhaust a specific property of the soil.

We will close this essay with quoting, from Chaptal, the principles which he lays down in regard to the alternating system of husbandry, and the conclusion he draws from them. His principles are—

“ 1. All plants exhaust the soil.

“ 2. All plants do not exhaust the soil equally.

“ 3. Plants of different kinds do not exhaust the soil in the same manner.

“ 4. All plants do not restore to the soil either the same quantity or quality of manure.

“ 5. All plants do not feed the soil equally.”

And from these principles he deduces the following conclusions :—

“ 1. That, however well prepared a soil may be, it cannot nourish a long succession of crops without being exhausted.

“ 2. Each harvest empoverishes the soil to a certain extent, depending upon the degree of nourishment which it restores to the earth.

“ 3. The cultivation of spindle roots ought to succeed that of running and superficial roots.

“ 4. It is necessary to avoid returning too soon to the cultivation of the same, or to analogous kinds of vegetables, in the same soil.

“ 5. It is very unwise to allow two kinds of plants, which admit of the ready growth of weeds among them, to be raised in succession.

“ 6. Those plants that derive their principal support from the soil, should not be sown, except when the soil is sufficiently provided with manure.

“ 7. When the soil exhibits symptoms of exhaustion, from successive harvests, the cultivation of those plants that restore most to the soil must be resorted to.

“ These principles are confirmed by experience ; they form the basis of a system of agriculture, rich in its products, but more rich in its economy, by the diminution of the usual quantity of labor and manure. All cultivators ought to be governed by them ; but their application must be modified by the nature of soils and climates, and the particular wants of each locality.”—*Chemistry applied to Agriculture.*



## CHAPTER XVI.

## ROOT CULTURE.

THE advantages of root culture to the soil, in the alternating system, have already been briefly alluded to ; but this culture possesses higher claims to our notice than the bare influence it has in ameliorating the soil : it constitutes, otherwise, by far the best means of economically feeding and fattening farm-stock, and adds greatly to the means of fertilizing the soil. It trebles the amount of cattle-food, and doubles the quantity of manure. It moreover may be made to supply a large portion of human food. Potatoes constitute a great portion of the bread and meat of the Irish peasantry—and there are no people more hale and robust than the Irish—feed their cows, fatten their pigs and poultry, and form an article of foreign commerce. The turnip has long been an important crop in Germany. The beet culture in France now furnishes annually a hundred millions of pounds of sugar, for human consumption ; while the refuse of the crop enables the French to enjoy the luxury of good beef and good mutton, which were scarce commodities with them before the beet culture was introduced. The field culture of the carrot has long been profitably adopted in Flanders. In the culinary, or kitchen department, the liberal use of roots has in a measure become indispensable to wholesome diet ; and while they are grateful to the palate, and promotive of health, they greatly economize the expense of bread and meat. In British husbandry, the introduction of root culture has been considered as important in increasing the products of the soil, as the application of steam has been to the improvement of the manufacturing arts. We will quote here a passage from the New Edinburgh Encyclopedia in confirmation of this fact.

“The introduction of turnips into the husbandry of Britain,” says this respectable work, “occasioned one of

those revolutions in rural art which are constantly occurring among husbandmen, and, though the revolution came on with slow and gradual steps, yet it may now be viewed as completely and thoroughly established. Before the introduction of this root, it was impossible to cultivate light soils successfully, or to derive suitable rotations for cropping them with advantage. It was also a difficult task to support live stock through the winter and spring months ; and as for feeding and fattening cattle and sheep for market, during these inclement seasons, the practice was hardly thought of, and still more rarely attempted, unless when a full stock of hay was provided, which only happened in a very few instances. The benefits derived from the turnip husbandry are, therefore, of great magnitude : light soils are now cultivated with profit and facility ; abundance of food is provided for man and beast ; the earth is turned to the uses for which it is physically calculated ; and, by being suitably cleaned with this preparatory crop, a bed is provided for grass-seeds, wherein they flourish and prosper with greater vigor than after any other preparation.”

Few of our farmers are probably apprized of the fact, that English beef and mutton, so highly extolled, and of which John Bull so vauntingly boasts—and perhaps no people have better—is mostly winter-fattened, without the addition of any sort of grain, upon roots and straw.

All of the field-cultivated roots are found well adapted to our soil and climate ; and where their culture has been undertaken with spirit, and managed with judgement, it has been fully demonstrated, that labor and capital cannot be more profitably applied in any other department of husbandry, than it can be in this. It gives the most cattle-food and most manure, important items in the economy of the farm, and leaves the soil in excellent order for grain and grass-seeds. The great obstacle to root culture, other than the potato crop, has been, the labor which is required to secure the roots from the frosts of winter ; and yet the labor and expense required for this purpose, are perhaps no greater than we expend in securing our grain and forage, if they are so great. Where cellars are

not adequate—and they may be constructed under barns with advantage—these roots may all be securely preserved in pits, in dry situations, due precaution being had to covering and ventilation. We *do* save potatoes, and we *can* save other roots in the same way. It is the *novelty* of the labor, rather than the *amount* of it, and a want of practical knowledge in their culture and preservation, which intimidate and deter very many. It has been demonstrated, in repeated experiments made in our country, that labor is more profitably bestowed upon root crops, if judiciously applied, and the profits of the land are greater, than in most of the other crops that we cultivate. Assuming the average product of hay at a ton and a half to two tons per acre, and of beets and ruta baga at 600 bushels—and allowing a bushel and a half of the latter (90 lbs.) to be equivalent, for farm-stock, to 20 lbs. of hay, an acre of the roots will go as far in the economy of feeding, as nearly three acres of meadow, to say nothing of the tops, which are excellent food, and which will, at least in a great part, compensate for the extra expense of culture. These roots, besides, may be used as a substitute for grain, to working horses and oxen, and for pigs. The three acres of grass are found to give less than 9,000 lbs. to the dung-yard, while the one acre of ruta baga, or beets, gives 36,000 lbs., or four times as much as the three acres of grass land.

Five things are essential in the culture of root crops : first, a dry soil ; second, a rich soil ; third, a deep soil ; fourth, a well-pulverized soil ; and, fifth, good after-culture. The crop will be abundant in proportion as these several requisites are regarded, and deficient in proportion as they are neglected.

By a *dry* soil, we mean a soil that is not wet. *Moisture* is beneficial to all crops, and is indeed indispensable to their growth ; but *water* is detrimental to all root crops, though it repose upon the subsoil, or appear but occasionally upon the surface. Hence, when roots are to be grown upon soils that are tenacious or flat, or upon those which repose upon an impervious subsoil, the land should either be previously under-drained, or should

be thrown into ridges, and the furrows kept open for the free passage of the water in heavy rains.

A *rich* soil is as essential to good crops, and particularly to root crops, as nourishing and abundant food is to the fattening of farm-stock. We all know that lean pasture and coarse forage, although they may *keep*, will not *fatten* cattle. It is equally true, that although farm-crops will live and grow upon a poor soil, the product and profit will be great only on a rich one. The advantage to the crop, as well as to the animal, will be in proportion to the quantity of organic matter which is converted into living organic matter—into vegetables and into meat. Mere earthy matters enter but minutely, or adventitiously, into the structure of either. Hence the maxim, verified by long experience, that it is better to cultivate one acre of rich land than three acres of poor land. The expense of cultivating the latter is threefold that of the former, while the product of the one rich acre, is often equal to the product of the three poor acres. Ordinarily speaking, a good dressing of manure will double the products of a root crop. To illustrate this fact more fully, we quote the following tabular statement from Arthur Young's experiments with potatoes. It is unnecessary to add, that Mr. Young was one of the most intelligent and careful agriculturists of the last generation. The preparation and culture were alike in all the cases noted below, except that in those marked with an asterisk (\*) the crop was manured, and in the others the crop was not manured.

No.	Preceding crops.	Expense.			Product, bushels.	Profit.			Loss.
		£.	s.	d.		£.	s.	d.	
1	Fallow, .	3	19	1	104 at 1s. 6d.	2	18	5	0 0
2	Barley, .	4	5	9	128 2 0	3	11	10	0 0
3	Wheat, .	6	13	6	46 0 20	0	0	0	0 0
4*	Do. . .	7	16	10	101 0 20	2	5	6	0 0
5	Do. . .	6	2	6	39 0 20	0	7	6	0 0
6	Do. . .	7	19	4	63 0 20	0	16	11	0 0
7*	Do. . .	4	14	5	170 0 20	9	2	0	0 0
8	Do. . .	8	9	3	30 0 20	0	0	0	15 6
9*	Do. . .	4	12	1	201 0 20	11	2	9	0 0

The three manured crops, it will be seen, gave an aggregate product of 472 bushels, and an aggregate nett profit of £22 10s. 3d., (\$99 90, say \$100;) the three adjoining plats, treated like the others in all respects but manuring, gave an aggregate nett product of 132 bushels, and an aggregate nett profit of but 8s. 11d., (\$1 96, say \$2;) thus showing that the manure, in these cases, produced an absolute gain of \$98, and that where it was not used, there was a mere nominal profit of two dollars. These facts will serve to show the reader, *first*, the great value of manure in farming operations, and to stimulate him to save and economize it; and, *secondly*, to show him the propriety of *always* manuring his potato and other root crops, which are equally benefited by the application, except a heavy dressing has been given to the preceding crop, for which, it is now generally admitted, the unfermented dung of the stables and cattle-yards is best fitted.

A *deep-worked soil* is necessary, for all but the potato crop, and even to this it is highly beneficial,—that the tap-roots of the beet, carrot, and turnip may not only penetrate freely, and increase their length and their volume, but that their radicles—their mouths—which are principally upon their lower extremities, may there find food for the parent plant. Even the turnip and the potato, in a deep tilth, send down their roots to a great depth, for food and moisture. This may be seen upon the borders of a field where the soil has been superficially ploughed, and where the product is always inferior, and most liable to suffer from drought.

The *pulverization of the soil* is essential to the germination of the seed, to the ready extension of the roots, to the free circulation in it of air and moisture, and the admission of solar heat, all contributing to prepare and transmit the food to the growing plants. If the soil is lumpy, or coarse, and does not come in close contact with the seed, to keep it moist, the seed cannot germinate; the roots cannot freely extend in search of food; nor can this food be properly prepared, and transmitted to the plant, unless the soil be so pulverized as to permit

the free circulation of air and moisture through all its interstices, and through its mass. The air and dews, we repeat, are charged with the elements of fertility, and the more freely they are permitted to penetrate the soil, the more benefit will they impart to the crop.

*Good after-culture* implies, the keeping of the ground free from weeds, which rob the crop of its food, thinning the plants to a proper distance, and keeping the surface mellow, or open to atmospheric influence. If the soil is dry, and rich, and deep, and well pulverized, the labors of the husbandman will yet not avail much, in root crops, if he neglects either to destroy weeds, to thin, when necessary, his plants, or to keep the surface loose and open. But these latter requisites to success may easily be got along with, if they are attended to in time, and with proper implements. The potato ground should be well harrowed, to destroy all the young weeds, and to pulverize the surface, before the shoots have all broke ground. It may afterwards be almost wholly managed with the plough and cultivator. The beet, carrot, and ruta бага, if sown, as they should be, in rows, should be cleaned in like manner, and for like purpose, with the cultivator, as soon as the rows of the young plants can be readily distinguished. One hour's labor, in this way, will destroy more small weeds, and correspondingly benefit the crop, than three hours' labor will effect upon large weeds. It is easier to destroy the acorn, than it is to eradicate the oak. To crowd plants, is like overstocking a pasture, or endeavoring to make fat animals from half rations of food. It is dividing among many that food which is required to perfect one. It moreover tends to exclude light, heat, and a free circulation of air, essential to the developement of vegetables, and the perfection of their growth. Hence a moderate number of plants will give a better product than a great many, upon the same ground, in a crowded situation. This is a hard lesson to teach to some farmers, in regard to root crops.

## CHAPTER XVII.

## ON SUBSTITUTING FALLOW CROPS FOR NAKED FALLOWS.

THE practice, under the old system of husbandry, has been, to plough up grass grounds in June, July, and August, for winter grain ; to cross-plough and harrow successively, and to sow upon them in September and October. In England the ground was ploughed the preceding autumn, and the ploughings and harrowings repeated during the succeeding summer till seed-time. The effect of this system was, the loss of the ground for a season, an unnecessary outlay of labor, and the wasting of a great portion of the fertilizing matters of the sward, by turning it repeatedly up to the surface. These labors and losses are in a measure superseded, by substituting fallow crops, that is, by taking a crop after one ploughing, upon the inverted sward. While this is growing, the sod is decomposing, the repeated ploughings are saved, the field is turned to profit, the tilth is in fine condition the next fall or spring, for small grains, and the soil receives all the benefit of the fertilizing properties of the sod. Old swards, especially if the soil is stiff, are ploughed deep late in autumn, and receive a superficial furrow, or a thorough harrowing, in the spring, to fit them for the fallow crop. Clover leys may be ploughed just before the seed is to be deposited, and the preparation finished by the harrow or roller.

There is no agricultural writer of note, and very few good farmers, who now advocate summer fallows, except on stiff clays, or wet grounds, which cannot be readily worked in spring or fall, and this principally for the purpose of cleaning them from perennial weeds. We subjoin some quotations, from high authorities, in corroboration of this fact.

“ Fallowing was necessary,” says Chaptal, “ as long as grains only, all of which exhaust the lands, were cultiva-

ted ; during the intervals of tilling the fields, a variety of herbs grew on them, which offered food for animals, and the roots of which, buried in the soil by the plough, furnished a great part of the necessary manure. But at this day, when we have succeeded in establishing the cultivation of a great variety of roots and artificial grasses, the system of fallowing can be no longer supported by the shadow of a good reason. The ease with which fodder may be cultivated, furnishes the means of supporting an increased number of animals ; these in their turn supply manure and labor ; and the farmer is no longer under the necessity of allowing his lands to be fallow. The suppression of the practice of fallowing is then equally serviceable to the cultivator, who increases his productions without proportionally increasing his expenses, and to society, which derives from the same extent of soil a much greater quantity of food, and additional resources for supplying the workshops of the manufacturer.”—*Chemistry applied to Agriculture.*

“ It is already acknowledged, that it is only upon wet soils, or, in other words, upon lands unfit for the turnip husbandry, that a plain summer fallow is necessary.”—*New Edinburgh Encyclopedia.*

“ As there is only one good reason for fallowing,” says Cooper, in the *Domestic Encyclopedia*, “ namely, to destroy weeds,—and as this can be done full as well by fallow crops, that is, by crops that require frequent cleaning during their growth, no fallows ought to be permitted in a good system of husbandry.”

Before root culture, or the alternation of crops, had obtained any thing like a footing among us, Chancellor Livingston—and we can ask no better authority—satisfied of the great loss of labor and farm-profits by the old system of farming, drew the following comparison between the advantages of summer fallows and fallow crops, predicated, we believe, principally upon his own practice.

“ I will endeavor,” says Chancellor Livingston, “ to state the profits and loss of two farmers, each cultivating, besides his meadows, one hundred acres of arable land, one in the usual [old] mode of this country, and the other by the intervention of vetches and clover.



“ *Common Agriculture, 100 Acres.*

20 acres in corn, 35 bushels, 50 cts.	£7 0 0
20 “ oats on corn ground of the preceding year, 20 bushels, at 2s.	2 0 0
20 acres summer fallow,	0 0 0
20 “ wheat, 10 bushels, at 8s.	4 0 0
20 “ wheat stubble in pasture,	0 2 0
<hr/>	<hr/>
100 acres. Five years' yield, per acre,	£13 2 0

“ *Expense per acre for five years.*

Indian corn, ploughing, &c.	£2 00 0
Oats, twice ploughed,	1 00 0
Harrowing, seed-sowing, and harvesting,	0 14 0
Summer fallow,	1 10 0
Wheat, seed and harvesting,	1 00 0
Rent on 5 acres, at 50 cts. a year,	1 00 0
<hr/>	<hr/>
	£7 4 0

Balance of profit on 1 acre in 5 years, or 5 acres in 1 year,	£5 18 0
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“ *Profit on Fallow Crops on Intervention of Fallow Crops instead of Fallowing.*

20 acres in Indian corn,	£7 0 0
20 acres in vetches, 25 cwt. at 2s. 6d.	3 2 6
20 “ in wheat, 12 bushels,	4 16 0
20 “ in clover, 25 cwt., 31 cents,	3 2 6
20 “ the same,	3 2 6
<hr/>	<hr/>
Five years' produce of one acre,	£21 3 6

“ *Expenses.*

Indian corn,	£2 0 0
Ploughing corn ground for vetches,	0 10 0
Seed, 3 bushels, sowing, &c.	0 12 0
Cutting and making hay,	0 8 0
Vetch stubble ploughed once for wheat, seed and harvesting,	1 10 0
12 lbs. clover-seed and sowing,	0 15 0

Mowing clover, paid by the second crop, . . . . .	0 0 0	
Rent, \$4 50, or 50 cents a year, . . . . .	1 0 0	
	<u>        </u>	£6 15 0
To balance of profit, per acre, in 5 years, or on 5 acres in 1 year, . . . . .		£14 8 6

“ Thus while one farmer makes £1 3s. 5d. a year per acre, upon his hundred acres, clear of expense, the other makes £2 17s. 6d. ; the one gets little better than one hundred, the other gets three hundred a year. In the above statement I have given one farmer credit for two bushels of wheat more than the other, since I am persuaded the vetch crop will improve the ground more than the difference, as the dung given to the corn will not be exhausted by this so much as by the oat crop, before the wheat is sown. To this profit should also be added the continued improvement of the crop by the one mode of husbandry, and the continued decrease by the exhausting the land in the other.

“ The fallow farmer has no fodder which the rotative farmer does not possess, except the straw of his oats, which we will value at half a ton of hay per acre. He then has from his oats, on 20 acres, ten tons.

The fallow farmer has, from 20 acres vetches,	25 tons.
From 40 acres of clover, . . . . .	50 “
	<u>        </u>
	75
Deduct the oat straw, . . . . .	25
	<u>        </u>
Superiority of fallow-crop farmer, . . . . .	50 tons.

“ He can thus winter, at one ton a head, 65 head of cattle more than the fallowing farmer ; and as each of these will afford at least six loads of dung, he will be able to carry out 390 loads of dung more than the fallowing farmer, besides that he has one exhausting crop less. It will be easy to see what difference this must make in a few years in the produce of a farm, and how much more it would be than I have rated it at. We often ask with astonishment, how the British farmer can afford to pay a

guinea an acre rent, [a tenth of his produce in tithes, a heavy poor-rate, and an enormous tax.] The difficulty is solved if we examine the above statement, since the difference between fallowing and establishing a rotation of crops amounts to more than the difference of our rents and theirs. I know there are some stiff soils on which it would be difficult to establish the rotation I mention, but this should be no argument against it where the soil will admit of it, particularly as clover and vetches may be introduced with a certainty of success, even if the ground should be naturally poor, by the addition only of gypsum, which will indeed add a few cents a year to the acreable expense, but it will, in all probability, at the same time add nearly a ton to the produce.

“ I would not be considered as confining my observation to vetches, which have not yet been sufficiently tried in this country ; potatoes or carrots, or peas sown thin, and cut green for provender, may all answer the purpose, but, above all, clover. If this last is the only crop to be brought into the rotation, the system must be changed to the following course : 1st, corn ; 2d, barley and clover ; 3d and 4th, clover ; 5th, wheat and one ploughing. By this means a crop of clover will be substituted for a fallow.”

Thus far Chancellor Livingston. We would add this suggestion, that as the culture of turnips and beets is now successfully progressing among us, and as the winter-wheat crop is becoming so precarious as to render a resort to the spring varieties of that grain probable, the following course would be better adapted to our husbandry than the one recommended above : first year, corn or potatoes, upon a clover ley, with long or unfermented manure ; second year, spring wheat with clover-seeds ; third year, clover cut in June, and fallowed with turnips ; fourth year, barley or oats with grass-seeds ; fifth year, meadow ; sixth year, pasture. In this way seven crops would be obtained in six years ; three of them would be decidedly ameliorating, and but two particularly exhausting ; and in five of the seven years the field would afford pasture in autumn. This course is particularly recom-

mended where manure is scarce ; as it is believed that manuring the first crop of the course well would keep up the fertility upon lands not very light and sandy, as it would embrace two grass leys. Where beets or carrots are to be cultivated, they may be made to follow the dunged crop of corn or potatoes, and be followed in their turn by barley, or oats, or wheat, and grass-seeds, thus giving a five-years' course, in which the field would give two grass, two exhausting, and one root crop. Two objections may be started to the first course ; first, that the clover cannot be cut in time to get in the turnip crop ; and second, that sowing grass-seeds twice in the course will be too expensive. To the first objection we offer our common practice, which is, to sow our ruta бага upon a clover ley—the southern or small clover—after the grass has been cut for hay, in June, so that the ruta бага may be sown before the first of July. The common turnip may be put in a month later. To the second objection we answer, that the value of the clover ley to the soil, to say nothing of the feed which it will afford to cattle, will twice repay the cost of the seed. We are satisfied, from experience, that it is profitable to sow clover with every crop of small grain, on soils adapted to its growth, merely for the purpose of enriching the land.

Before we close this subject, we will quote, from 'British Husbandry,' two highly-successful experiments, made upon clay farms, in substituting fallow crops for naked fallows. Although our crops differ somewhat from those cultivated in England, yet the hints and demonstrations which these examples afford, will not be lost on the American farmer. The two following are the cases alluded to, which we give in the words of the British editor.

#### “ GREG'S SYSTEM.

“ The farm of Coles, near Buntingford, in Hertfordshire, consists of 240 acres of arable land, which is described as ' a very tenacious clay, in some places mixed up with calcareous earth, which causes it to bind at top after heavy rains ;' and was formerly worked nearly un-

der a three-course system of summer fallow, white corn, and pulse, or clover. Turnips were seldom sown, as the difficulty of feeding or carting them off was found to be injurious to the succeeding crop; and, consequently, only a small flock of 80 ewes or 140 wethers was kept, which was constantly folded during the summer. Upon this, and the observations regarding the disadvantages attending the similar plans of his neighbors, it is unnecessary that we should here offer any remark, for we know that they have been, in many instances, improved, and our more immediate object is to state the system afterwards adopted by Mr. Greg, and since followed by his nephew, during upwards of twenty years.

“Having, as he tells us, ‘established in his mind, as a general principle, that fertility was to be derived from pulverizing the soil, clearing it from water, and keeping it clean, he proceeded to inquire how those objects were to be obtained at the least expense; and he found that the best method to promote them was to reverse the whole system of the former cultivation.’ Accordingly, instead of ploughing four or five times only, in summer and spring, and fallowing every third year, he formed the determination ‘to plough only once for a crop; to plough only in winter; never to fallow the land in summer; to practise the row-culture, and to use the horse-hoe.’ The mode in which he carried his plan into execution was as follows.

“He divided the farm as nearly as possible into six equal parts, which are cultivated in a six-course shift, consisting of turnips; barley or oats, clover, standing two years; peas or beans, upon the ley; and lastly, wheat. The ground is marked out by a drill into ridges of five and a half feet in width, intersected by furrows of ten inches wide; thus leaving only fifty-six inches for each land, which is worked by a Suffolk swing plough, formed upon a construction to cut a perfect trench of seven inches deep, and requiring four bouts to complete the ridge, which is made sufficiently convex to describe an inclined plane of three inches from the crown to each furrow. Thus water is prevented from remaining upon

the land intended to be cropped, by being drawn into the ten-inch furrow, which is carried two inches deeper ; the horses never tread but in a furrow ; and by the soundness of this ploughing Mr. Greg states, that ' when effected in the autumn or before Christmas, a perfect friability is obtained in the tilth by the influence of the frost during the winter, and the surface-water may be as effectually got rid of as by under-draining.'

“ As soon as the harvest is completed, the wheat-stubbles are haulmed, and the lands are marked out and ploughed one bout : dung is then ploughed in to the amount of ten loads per acre, and three bushels of winter tares with a bushel and a half of winter barley are sown, to precede turnips, to the extent of about half the ground intended for that crop, which, in common seasons, it does not impede, as the tares are cut upon a moist furrow for the turnip-sowing.

“ The tare-sowing being finished, the bean and pea-stubbles are prepared for wheat ; which is a difficult operation on heavy land, when the object is to get the seed early into the ground. The labor which they require from the plough, roll, and harrow, was so great as to induce Mr. Greg to use a powerful grubber, or scarifier, of a form which covers an entire land ; and it performed so well that he has since continued to use it instead of the plough, as he found that he could thus sow forty acres of wheat in a very few days, regardless of weather, and at a sixth part of the expense.

“ Having sown the wheat, the remainder of the land intended for turnips is ploughed and dunged. The ploughing is also performed for peas and beans ; and it is desirable that these operations should be completed before Christmas. As soon as the season turns, the land which was ley, and intended for beans and peas, is scarified ; and when the growing weather commences, the beans are drilled at fifteen inches, for the convenience of horse-hoeing. The peas are next drilled ; but as these, by falling over, preclude the possibility of hoeing them more than twice, they are sown at intervals of twelve inches.

“ As the ground is cleared of turnips, it is ploughed

into lands. In the spring, the barley is drilled in rows of eight inches—not leaving any space for furrow—and the clover and rye-grass is sown up, and then across the lands.

“As soon in May as the weather permits, and the sun is sufficiently powerful to kill weeds, the scarifier is set to work, succeeded by a strong harrow; and having by these operations obtained cleanliness, the first favorable weather is made use of to sow Swedish turnips; or, should they fail, they are succeeded by white turnips, and in the event of a further miscarriage, coleseed is sown. With these, and the assistance of about ten loads of clover, and ten weeks’ run on pasture in bad weather, 500 sheep are now kept on the farm, but lie enclosed at night in a spacious and well-littered yard. The fodder produced by straw and clover-hay supports from forty to fifty head of cattle, and nine working horses are kept, which are soiled during the entire summer: thus so large a quantity of dung is made that no manure is purchased.

“In this manner 200 acres are ploughed between harvest and Christmas, besides the cartage of dung and other odd jobs on the farm; but this is easily performed with the aid of the grubber, and the land being entirely ploughed in the winter, there is only the sowing of Lent corn to execute in the spring: the horses are therefore put upon green food, by which a considerable saving is made in the consumption of corn. Many other details of management are given in Mr. Greg’s pamphlet, which is brief and well worthy of attention, but which we refrain from enumerating, as we only meant to call attention to the extraordinary statement which it contains, of such a system of culture having been so successfully pursued upon land of that nature, as to yield an average, during six years, of the following crops, namely:

	Per acre.
Wheat, . . . . .	25 bushels.
Barley, . . . . .	40 “
Beans, . . . . .	35 “
Peas, . . . . .	30 “
Clover, twice cut, . . . . .	2 tons.

Thus, after the deduction of rent and the interest of

£2,500 capital, presenting, upon an average of six years, a profit of £671 3s., or £2 15s. 11d. per acre, and a result in favor of his mode of cultivation of no less than *an annual difference amounting to £638 13s.*

“Of the accuracy of the minute account thus furnished by Mr. Greg, we have no reason to doubt, though we confess ourselves somewhat skeptical regarding the justice of the conclusions which he has drawn respecting the superiority of his own plans over those of his neighbors ; for every man, however high his honor and impartiality, is yet unconsciously biased in favor of any pursuit of his own, and no farmer could live upon the profit which he has assumed as that of cultivation under the old plan. On a subject of such vital importance to agriculture as that of the fallow system, we indeed deemed it prudent to apply to the present Mr. Greg for further information, which he readily afforded ; and, from recent personal communication and correspondence, we are assured by him, ‘that his uncle’s system is still pursued upon his farm with the best effect ; as is evinced by the clean condition of the land, the heavy crops produced, and the quantities of stock maintained. The only alteration of importance made in his mode of cultivation subsequent to the publication of his pamphlet, was the substitution of a seven-years’ course, in place of that of six years, by which he obtained two crops of wheat—one on the clover ley, and another after the beans and peas. The annual course of cropping in the several years now, therefore, stands thus :—

- |                   |                    |
|-------------------|--------------------|
| 1. Turnips.       | 5. Wheat.          |
| 2. Barley.        | 6. Beans and Peas. |
| 3. and 4. Clover. | 7. Wheat.          |

“No material alteration has been made in the implements ; nor was any fallow permitted so long as the late Mr. Greg’s health allowed his superintendence of the farm ; but the bailiff now *occasionally fallows a field of the heaviest land* : this, however, is only resorted to when the land sown with turnips has not been prepared in time for the barley crop, and only averages about 16 acres a year out of 250.’ ”



“BEATSON’S SYSTEM.

“Knowle Farm, in the neighborhood of Tunbridge Wells, which was a few years ago in the occupation of the late General Beatson, contains about 300 acres of land, of which 112 are arable, and is described as abounding with clay, and retentive of surface moisture, but when dried by the summer heat, it becomes as hard as a brick, and impervious to the plough, unless with a great power of animal exertion, particularly as the general mode is to plough deep. The established rotation in that part of Kent and the neighboring portion of Sussex, is fallow, wheat, and oats, with occasionally clover and rye-grass; and the husbandry appears to have remained unaltered for many ages, with the single exception of substituting lime for manure instead of marl. Upon this system the farm was managed during the General’s absence, while Governor of the Island of St. Helena; and finding on his return, in the year 1813, ‘that he had no cause to boast of its profit, he resolved to trace the whole progress of the operations, from the commencement of the fallow to the close of the rotation;’ the result of which was, that, ‘having made a series of experiments, to which he devoted his attention during five years, he determined upon *the total abolition of fallows.*’\* ”

\* His experiments were extended to various objects besides the working of the land; particularly to the combinations of different kinds of manure, and the burning of clay, (for which, see our vol. i. chapters 16 and 17;) but our present extracts only extend to the subject of fallowing, the charges of which he states to have amounted to £16 per acre, thus:—

Labor, breaking up the clover ley and 3 subsequent ploughings, . . . . .	£3 12 6
Eleven harrowings, at ten acres per day, . . . . .	0 9 0
Manure, one and a half wagon-load of lime, between the third and fourth ploughings, . . . . .	7 10 0
Carting and spreading ditto, . . . . .	0 6 0
Seed, two and a half bushels of wheat, at 10s. . . . .	1 5 0
Sowing and rolling, . . . . .	0 1 6
Rent and taxes for the year of fallow, . . . . .	1 10 0
Ditto for the year of crop, . . . . .	1 10 0
	<hr/>
	£16 4 0

“In order to effect this, he adopted several new implements, chiefly of his own invention, for a description of which we must refer to his ‘New System of Cultivation,’ as we have only seen the scarifier in use. This is of a light construction, and certainly performs well; though, upon land such as that described by the General, it is worked by a pair of horses, and sometimes more, instead of one.

“He conceived that the grand source of all the heavy expenses of the old method might be traced to the fallow itself, and to the mode of preparing it—‘by bringing up immense slags with the plough, by reversing the soil, and thus burying the seeds of weeds that had fallen on the surface, by which a foundation is laid for all the subsequent laborious and expensive operations.’ To avoid these, he therefore thought it necessary to proceed in a different manner—‘to only break and crumble the surface-soil, to any depth that may be required; to burn and destroy the weeds; after which he would have the land in a fine and clean state of pulverization, and in readiness for receiving the seed, without losing a year’s rent and taxes; and all this at a mere trifle of expense, when compared with that which is incurred by a fallow.’

“In pursuance of this, he reduced the ploughing to a single operation at the depth of four inches. The chief use, indeed, which he made of the plough was to open furrows at twenty-seven inches apart, which was performed by a couple of horses at the rate of three acres per day, and was merely intended to prepare the land for the scarifiers, ‘which, by passing twice across these furrows, loosen all the stubble and roots of weeds, which are afterwards, with a small portion of the soil, placed in heaps and burned.’ By these means, together with the more frequent repetition of the horse-hoeing, and the introduction of the row-culture, the General assures us ‘that his lands were rendered much cleaner, and yielded better crops than they did formerly, after all the heavy expenses of lime and fallows.’ He indeed states, that these operations produced the effect of pulverization to the depth of six or seven inches, and their expense was—

Five scarifyings, with a single-horse implement, at 1s. 8d. per acre,	£0 8 4
Two harrowings, at 10½ . . . .	1 9
	———— £0 10 1

that the whole charge of cultivation, under a four-course system upon this plan, including rent, was—

Tares, beans, peas, &c. per acre,	£5 0 0
Wheat, . . . . . “ .	5 0 0
Oats and barley, . . . . . “ .	3 13 6
Clover and rye-grass, . . . . . “ .	2 15 0
	———— £16 8 6

thus only amounting to a trifle more than that of the fallow upon the former plan ; that land cultivated upon his farm in this manner has yielded 460 sheaves of wheat per acre, whilst the average produce of the other fields did not exceed 360 ; and that the *difference in favor of the new method amounts, upon an average*—when wheat is at 10s. the bushel—to £350 per annum upon the cultivation of 100 acres.”—*British Husbandry*.

We have endeavored, as we proposed, to demonstrate the practicability of improving the soil, of increasing its products and its profits ; of thereby multiplying the means of subsistence and comfort ; of rendering our farmers, who must give the impress to our character as a people, more intelligent, industrious, and virtuous, and our nation truly independent ; we have endeavored, we say, to show, that all these desirable ends may be promoted by manuring, draining, and good tillage ; by alternating husbandry, by extending the culture of root crops, and by substituting fallow crops for naked fallows. We have endeavored also to show, that our suggestions, in all these branches of improvement, are sanctioned by the principles of science, and have been amply verified in practice. If the principles we have assumed be correct, and the practice we recommend in conformity with the sound principles of natural philosophy, then the old-fashioned farmer is admonished thereby to change his course of practice, if he would prosper in his business,—to study, to practise, and to adopt the new system of husbandry, so far as his

soil and circumstances will permit ;—to drain his wet lands, economize his manures, and to apply them before they are half wasted,—to till well what he does till,—to alternate his crops,—to extend his root and clover culture,—to increase his stock as the products of his farm will permit,—and to substitute fallow crops for summer fallows. And the settler on new lands is admonished to adopt a like course, if he would preserve the fertility of his soil, and render his lands permanently productive.

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## CHAPTER XVIII.

### ON THE ADAPTATION OF PARTICULAR CROPS TO CERTAIN SOILS.

It is well known that certain plants are found to abound most naturally in particular soils, and that some plants are almost exclusively confined to such—as primitive, transition, and secondary ; silicious, calcareous, or argillaceous ; dry or wet ; rich or poor ;—and botanists pretend to determine, from the examination of a plant, its peculiar habitation. It is reasonable to conclude, from analogy, that cultivated plants have their preferences, as to soil, as well as those which grow naturally. Indeed, we have abundant proofs of this fact, in our ordinary farming operations. This subject has long engaged the attention of Dr. Von Thâer, the distinguished Principal of the Prussian school of Moegelin. The following table exhibits a classification of soils, particularly adapted to the crops designated, with their elementary parts, and relative value, both in regard to the soils and the crops which they produce. Although the real value of every rotation depends, in a great measure, upon the manner in which its several processes are executed, and upon the demands of the market ; yet, abstractly speaking, some courses must be considered as better than others, because the crops may be more suitable to the peculiar qualities of the land on which they are to be grown.

Nos.	SOILS.	Clay, per cent.	Sand, per cent.	Carb. of lime, per cent.	Humus, per cent.	Value.
1	} First class of strong wheat soils, . . . . . }	74	10	4 $\frac{1}{2}$	11 $\frac{1}{2}$	100
2		81	6	4	8 $\frac{1}{2}$	98
3		79	20	4	6 $\frac{1}{2}$	96
4	} Rich barley land, . . . }	40	22	36	4	90
5		20	67	3	10	78
6	} Good wheat land, . . }	58	36	2	4	77
7		56	30	12	2	75
8	} Ordinary wheat land, . }	60	38		2	70
9		48	50		2	65 $\frac{1}{2}$
10		68	30		2	60
11	} Good barley land, . . }	38	60		2	60
12	} Ordinary barley land, . }	33	65		2	50
13		28	70		2	40
14	} Oat and rye land, . . }	23 $\frac{1}{2}$	75	} Small quantities in each.	1 $\frac{1}{2}$	30
15		18 $\frac{1}{2}$	80		1 $\frac{1}{2}$	20

It will be perceived that the wheat soils possess from 40 to 81 per cent. of clay, from 4 to 36 of carbonate of lime, and from 4 to 11 $\frac{1}{2}$  of humus, or geine. Lime seems to be an indispensable ingredient in a wheat soil. Neither barley, oats, nor rye, and we may extend the remark to Indian corn and turnips, and indeed to many other farm products, requires carbonate of lime, though this always gives a chemical and mechanical improvement to the soil, by rendering sands more compact, and more retentive of moisture and manure, and clays more light and pervious to atmospheric and solar influence, and to the roots of the crop. All the soils in which sand predominates over clay, are best adapted to the growth of Indian corn, turnips, clover, &c., though the product will depend on the soluble organic matter in the soil, and the fidelity of the culture.

Nos. 1, 2, and 3 are alluvial soils of the richest quality, and embrace much of the land upon the lower flats of rivers coming from secondary and transition formations, and a large portion, it is believed, of the secondary formation

lying west of the Alleghany range of mountains ; and from the abundance of vegetable mould, or humus, which such soils contain, and the intimate state of admixture with earthy materials in which it is found, they are not so stiff as the quantity of clay which they contain would seem to indicate. But their texture will become more compact as the vegetable matter becomes exhausted by bad husbandry. From the absence of lime in most of the primitive formation east of the Alleghanies, many districts, although not deficient in the other ingredients, are not found congenial to the growth of wheat.

No. 4 is a fine clay loam, such as abounds in many limestone districts, and contains a very large proportion of carbonate of lime. The application of lime or marl to such a soil would be a waste of time and money. Indeed, while there is four per cent. of carbonate of lime in a soil, it is doubted whether these applications can be made with any advantage.

No. 5 may be termed a very rich sand loam, in which there is one fifth clay, one tenth humus, or organic matter, and a sufficiency of carbonate of lime for ordinary purposes. This soil is easily worked, is adapted to alternate husbandry, if made dry, and, although graduated a tenth below No. 1, is probably as profitable a soil as the farmer can cultivate.

Nos. 6 and 7 may be denominated kind clay soils, about upon a par with No. 5, clay more preponderating in their composition, and with less than half the humus that No. 5 contains—a deficiency, however, which a good farmer would soon contrive to remedy.

Nos. 8, 9, and 10 are rated of less value than the preceding, because they are deficient in carbonate of lime and humus. Upon these, it is presumed, mild lime, and marl, and ashes would prove beneficial, and would raise them to the value of Nos. 6 and 7. All of these numbers, and those which follow, may be considered as corn, turnip, and clover soils, if the deficiency of humus is supplied by manuring.

Nos. 10, 11, and 12 form the lightest classes of soils, and are termed sandy, from the preponderance of

sand over clay. These lack carbonate of lime, and humus and clay; and clay-marl or blue clay, or indeed any clay, properly applied, would constitute an excellent dressing for them. Green crops, of any sort, turned under with the plough, are here particularly serviceable. When duly enriched they will bear good rye. Clover, or other green crops, should frequently intervene in the alternation. If dry, sheep may be advantageously pastured upon them.

We will here make some suggestions as to the mode of applying marl or clay to sandy lands, though at the risk of repeating what we may have already said upon this subject. The object of the application is to improve the absorbent and retentive properties of the soil, as it regards moisture and manure. It is hence important that the clay or marl should be pulverized and intimately incorporated with the soil. Pulverization can only be effected by exposing the marl or clay to the action of the frosts, rains, and the sun. If laid upon the ground in masses, or heaps, pulverization is but partially effected, and that only upon the surface of the heaps. It is advisable therefore, and it is the practice we have settled upon, to draw the clay or marl on to the ground in autumn or winter, and to spread from the carts, as far as its adhesive quality will permit, over the entire surface of the field. The lumps become saturated with rain, the frosts penetrate, expand their volume, and loosen their adhesive properties, and when the clay or marl afterwards becomes dry, they may be broken down by a maul, and pretty well pulverized and distributed by the roller and harrow. The operations of tillage will then produce as good a mixture as can be expected. Were the attempt made to blend these materials with the soil, without the preparatory process of pulverization, much of the benefit of the application would be lost. Besides, the clay and marl, by exposure to atmospheric influence, part with deleterious properties which they often possess when drawn from the pit, and are ameliorated and enriched by the atmosphere. Judging from experience, we consider twenty or thirty-two horse loads of blue clay, containing, like that

about Albany, 25 to 30 per cent. of carbonate of lime, applied, agreeably to the foregoing directions, to an acre of land like Nos. 14 and 15 of the above table, of more ultimate benefit than an equal number of loads of barn-yard manure.

The majority of soils do not contain more than five per cent. of humus ; and, as we have observed, many contain little or no carbonate of lime. Without the first, no admixture of earths can be productive ; and without the latter, wheat, and probably some other farm-crops, cannot be grown to advantage. Yet where there is a due admixture of sand and clay, two per cent. of carbonate of lime, and an equal proportion of humus, will render the soil productive, for a season, or until the lime and the dung are too far exhausted by the growing crops. Sandy soils are much more easily wrought than clay soils ; and if they are tolerably well dunged and managed, or if green crops are made frequently to alternate, they make a good return to the husbandman. Under constant tillage they are soon exhausted ; and it is but seldom they are found to yield a succession of grass crops. Alternate husbandry should therefore, at all events, be resorted to upon soils of this description.

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## CHAPTER XIX.

### EFFECTS OF CROPPING AND MANURING.

THE reader will find a further illustration of the benefits of manuring, of alternating crops, and of abolishing naked fallows, in the facts and suggestions which we are about to present him.

We have heretofore endeavored to make it plain, that living and dead plants contain the same elementary matters,—that dead plants afford the proper aliment for living plants,—and that, consequently, the fertility of a soil will be increased or diminished, in proportion to the quantity of dung or organic matter which is returned to it,

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compared to the quantity which is taken from it by cropping. New or virgin soils may contain a large supply of vegetable matter, or humus, or soluble geine, terms which mean much the same thing, or they may contain an abundance of the specific food of certain plants, as of wheat, for instance, enough to feed several successive crops ; yet the powers of fertility are diminished by every succeeding one, if the crops are carried off from the field, and nothing returned to it to supply the loss,—until finally, if the system of cropping goes on in this way, the food of plants will become exhausted, and the land sterile and barren, for all the profitable purposes of husbandry. If we look to the old continent, we shall perceive that large districts, once fertile and populous, have, by the injudicious management of the husbandman, become almost waste and depopulated. A great portion of Egypt, of India, of Asia Minor, of the Barbary States, and of Spain, which once sustained their millions of inhabitants, and were to the world examples in the arts of culture and civilization, may be cited in illustration of this fact. And if we will turn our eye upon the Atlantic border of this new continent—new at least in cultivation and improvement—we shall see ample evidence of the melancholy tendency of the old, the exhausting system of husbandry. We shall see millions of acres of once fertile lands, formerly in as high repute as the *El Dorado* of the west—the land of promise—worn out and exhausted of their fertility, by the old wretched system of cropping, cropping, cropping, until they have been thrown into “*old fields*,” or commons, as unworthy of culture. And even in the fertile west, from the abuse of those who are charged with their culture, are the lands in some districts assuming the garb of old age and unproductiveness, and their occupants are passing further west, to seek out and exhaust the patrimony destined for coming generations.

If we put an ox to a stack of hay, he may subsist upon it a longer or shorter time, according to the quantity of food which it contains. A constant diminution of his food is going on ; and although he may feed and fatten till the

last lock is consumed, it is very certain, that unless the stack, or the food, is replenished, the ox, when the stack is consumed, will hunger and die, for want of nourishment. The organic matter in the soil is the stack of hay, and the crops are the ox. As long as the organic matter continues in sufficient quantity, the crops will thrive ; but the moment the organic matter is exhausted, or is deficient in quantity, the crops, like the ox, will pine and die, for want of food. The herdsman takes care to provide fresh food for the ox before the stock of hay is exhausted ; and the prudent farmer will take like precaution to provide for the coming wants of his crops. Providence has imparted fertility to the soil for the benefit of man, to whose management He has intrusted it ; and He has endowed him with the faculty, and provided abundant means, of perpetuating that fertility. How reckless and improvident do we consider the young spendthrift, who wantonly squanders his paternal inheritance. He not only injures himself, and perverts a noble object of his being—that of doing good to his fellows—but he does injury to others by his bad example, and robs his children of their inheritance. The contemner of Nature's laws, who wantonly wastes the bounties of Providence, by a reckless, exhausting system of husbandry, does injury to himself and others of a like nature, though not perhaps to equal extent, nor in so glaring a manner, as the spendthrift who squanders, in vice and folly, his paternal estate.

Crops exhaust the fertility of the soil in proportion to the nourishment they respectively draw from it. To keep up our comparison with the animal kingdom, we may liken our grain crops to our cattle and horses, which are gross feeders, and consume a large quantity of food ; and our grass and roots to sheep and swine, which consume less, which thrive on comparatively scanty and coarse fare, and in a measure requite us for their food, by their intrinsic value, and by the fertility which they impart to the soil. The hog and the sheep, the grass and the roots, will *live* upon the pasture or soil which will not sustain the more gross feeders—the grain and the cattle—yet, like the latter, they will only thrive well when well fed.

Von Thâer, who has not, perhaps, his superior in the practical and scientific business of farming any where, has turned his attention, for several years, to a series of experiments and observations, with a view to ascertain the degree of diminution or augmentation of fertility, which soils ordinarily experience from the culture of the principal farm-crops, and has combined the results of his observations in a series of tables. Although these do not possess perfect accuracy, for any thing like this would be impossible from the nature of the inquiry, they nevertheless serve as useful data to farmers who are anxious to preserve or to increase the fertility of their soils, by judicious rotations, and by applying all the means of fertility which the farm affords.

“The vegetative power,” says ‘British Husbandry,’ “is supposed to be in proportion to the quantity of *humus*, (or soluble vegetable matter,) or mould, which is contained in the soil, and its consumption has been found to be regulated according to the amount of nutritive matter consumed by the crops which are grown upon it. The degrees of exhaustion thus occasioned, have only been fixed by naturalists with any degree of certainty, in so far as regards the usual species of cultivated grain and pulse; for, as to the other products of the earth, although they have doubtless similar effects when similarly repeated, yet those which consist of vegetable roots and grasses, and which are drawn from the land before they have perfected their seed, are nevertheless—whether from the influence attributed to their shade upon the soil, from sustenance drawn from the air and water, or from other causes with which we are not acquainted—only viewed as ameliorating crops. Corn crops are, however, considered respectively to exhaust in proportions which render the proportion of about  $4\frac{1}{2}$  bushels of wheat equal to that of 6 bushels of rye,  $8\frac{1}{2}$  of barley, and 12 of oats.”

“According to all the experiments which have been made, there is reason to suppose, however, that upon a soil of moderate fertility, an average crop of wheat empoverishes the land to the extent of 40 per cent., while one of rye only produces that effect as far as 30. Al-

though barley is more exhausting than oats, yet, upon strong land, in a less perfect state of culture, the latter produces proportionably larger crops, consequently absorbs more nutriment; and, for this reason, they may be both stated at 25 per cent.

“The exhaustion by these crops is proportionably repaired, and the land is restored to its former nutritive powers, in three ways, namely—

“By the application of putrescent manure; according to its quantity and quality.

“By the ground being left a certain time under pasture; according to the number of stock which it can support.

“By the operation of a summer fallow; according to the manner in which it is performed.”

Von Thâer considers the exhaustion by grain crops in the following relative proportions:—Wheat 4 degrees, rye  $3\frac{1}{4}$ , barley  $2\frac{1}{4}$ , oats  $1\frac{6}{10}$ , per bushel of product; that upon poor soils, whose original fecundity is 40, according to the scale given in the preceding chapter, a fallow adds 10 degrees to its fertility, pasture 20, and 8 tons of manure, of ordinary quality, 50 degrees—so that the manure and fallow, or manure and pasture, add 60 or 70 degrees, and are more than sufficient to double what the crop would have been without them. Without them, a crop of rye would have yielded but five bushels per acre; with them, the yield would be  $7\frac{1}{2}$  to 10 bushels. A fallow is beneficial, not only on account of the fertilizing properties it may draw from the atmosphere, and by the influence of working the land, but from the weeds and vegetable matters which it buries in the soil. Pasture is fertilized by the droppings of the stock, and the rich sward it gives to the plough and to the tilled crop.

In the two following tables, the *journal*, which is about two thirds of an English acre, is the measure of land experimented upon. The *schiffel* is more than a bushel and a half, Winchester measure. These tables are predicated upon accurate experiments, and show the augmentation or diminution of fertility, caused by the crops, the manures, the pasture, and the fallow.

## TRIENNIAL SYSTEM.

<i>Crops and manures.</i>	<i>Fecundity.</i>	
	<i>Augmentation.</i>	<i>Diminution.</i>
Fallow, . . . . .	10 deg.	
6 4-10 loads of manure, . . . . .	67 deg.	
Rye, 6 schiffels, . . . . .		30 deg.
Barley, 6 do. . . . .		21 deg.
Fallow, . . . . .	10 deg.	
Rye, 3½ schiffels, . . . . .		17½ deg.
Oats, 4 do. . . . .		10 deg.
Fallow, light folded, . . . . .	28 deg.	
Rye, . . . . .		20 deg.
Oats, . . . . .		10½ deg.
	115 deg.	109 deg.

By which course, land would gain six degrees of fertility in nine years, provided the manure was that of well-fed cattle ; but if principally straw, it probably would occasion no amendment.

## ALTERNATE SYSTEM.

<i>Crops and manures.</i>	<i>Fecundity.</i>	
	<i>Augmentation.</i>	<i>Diminution.</i>
9 loads of dung, . . . . .	90 deg.	
Potatoes,* 80 schiffels, . . . . .	10 deg.	30 deg.
Barley, 9 do. . . . .		31½ deg.
Peas, . . . . .		10 deg.
3¾ loads of manure, . . . . .	37½ deg.	
Rye, 8 schiffels, . . . . .		40 deg.
Clover, mown, . . . . .	12 deg.	
Pasture, . . . . .	20 deg.	
Oats, 11 schiffels, . . . . .		27½ deg.
	169½ deg.	139 deg.

\* The augmentation of fertility is here added, because of the culture bestowed upon the potatoes as a fallow crop, the value of which is considered equal to 10 degrees.

This course would augment the fertility of the soil, in eight years,  $30\frac{1}{2}$  degrees, besides producing crops of superior value. This increase is owing to the clover and pasture, and the additional quantity, as well as superior quality of the dung, made by cattle fed upon roots and clover. Land is progressively improved by the production of good crops, consumed upon the farm, and the manure which they supply, if the latter is properly husbanded and applied.

This will be rendered still more apparent by the following summary of four different rotations actually carried into effect, and each consisting of 120 journals, or equal to 76.1.6 11-5 acres English, and bearing the crops here mentioned, after deducting the seed.

## No. 1.

<i>Courses of crops.</i>	<i>Product per journal.</i>
Fallow dunged.	
Rye, . . . . .	$8\frac{1}{2}$ schiffels.
Barley, . . . . .	$8\frac{1}{2}$ do.
Oats, . . . . .	8 do.
Clover and mown, . . . . .	14 centnus.*

Ditto pasture two years, together with 170 journals of extra meadow and sheep-pasture.

## No. 2.

Oats upon pasture ley, . . . . .	12 schiffels.
Fallow dunged.	
Rye, . . . . .	10 do.
Barley, . . . . .	10 do.
Rye, . . . . .	5 do.
Clover and mown, . . . . .	20 centnus.

Ditto pastured two years, together with 100 journals of extra pasture meadow, dunged.

## No. 3.

Potatoes, . . . . .	87 schiffels.
Barley, . . . . .	12 do.
Clover, . . . . .	24 centnus.

\* The centnu is 103 lbs. English.

Oats,	.	.	.	.	14 schiffels.
Peas,	.	.	.	.	6 do.
Rye,	.	.	.	.	10 do.
Tares,	.	.	.	.	20 centnus.
Rye,	.	.	.	.	9 schiffels.
Meadow dunged,	.	.	.	.	15 centnus.
Besides 100 journals sheep-pasture.					

## No. 4.

Oats upon pasture ley,	.	.	.	.	14 schiffels.
Fallow, sown both before and after with winter and spring tares for fodder,	.	.	.	.	20 centnus.
Rye,	.	.	.	.	10 schiffels.
Peas,	.	.	.	.	6 do.
Rye,	.	.	.	.	9 do.
Potatoes,	.	.	.	.	87 do.
Barley,	.	.	.	.	12 do.
Clover mown,	.	.	.	.	24 centnus.
Ditto pastured with sheep 2 years.					
Meadow, 150 journals dunged, 15 centnus.					

The produce of these several crops, both in fodder and manure, as well as in grain, and the profit gained by feeding of stock, were then summed up, and being calculated according to the price of grain, were reduced to schiffels of rye, from which were deducted the charges of cultivation, thus affording a parallel between the different courses, as follows:—

Nos.	Product of straw.	Produce of fodder, reduced in wt. to an estimate in hay.	Manure.	Profit on cattle.	Profit of grain.	Nett balance.
	Centnus.	Centnus.	Centnus.	Schiffels.	Schiffels.	Schiffels.
1	4173	2936	14219	992	1948	1869
2	6464	4650	22228	1651	2958	3028
3	7916	9120	29272	2430	2960	3458
4	10973	12315	41791	3178	4323	5188

It appears from these results, that the fertility of the soil, and the consequent profits of the farm, were increased,

*First.* In proportion to the augmentation of manure, by reason of meadow, green crops, and roots ;

*Secondly.* In proportion to the increased ratio which the above-named crops and pasture bear to the grain crops. And,

*Thirdly.* In proportion to the amount of pasture.

And it will be further seen, that the courses were profitable, and the fertility of the soil increased, in proportion as green, leguminous, and root crops were alternated with grain crops—the two first, and least profitable courses, giving three grain crops in successive years—the third course intervening clover, peas, or tares between the grain crops—and the fourth and most profitable course alternating dry, green, leguminous, and root crops, followed by clover mown or pastured three years.

The inference from these experiments, made by one of the most intelligent and careful of men, is, that if we would preserve or increase the fertility of our lands, and thus augment the profits of our labor, we should not sow dry crops for two successive years, upon the same field—but alternate them, as far as practicable, with roots, legumens, green crops, meadow, and pasture.

The reader will find these matters more largely treated of in ‘British Husbandry,’ and particularly in Von Thâer’s works on agriculture.

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## CHAPTER XX.

### RULES AND SUGGESTIONS IN FARMING.

WE shall now proceed to offer some rules and suggestions in husbandry, of general application, to enable farmers, and particularly novices in the business, to judge of the character and qualities of their soil,—of its adaptation to particular crops,—of the causes of deterioration,—and of the means of perpetuating its fertility ; or, if worn out or empoverished, of restoring it to its primitive vigor. These facts or suggestions form a sort of synopsis, or



epitome, of what has been stated in the preceding essays of the principles and practice of the New Husbandry. Though they may not in all cases fully apply, they will in the main, we believe, be sound and useful.

1. The essential elements of a good soil, are sand, clay, lime, and organic matter. Magnesia, iron, and various other minerals and salts, are often found blended with the preceding ; but in general they are not considered as exercising a great influence upon its fertility, except they exist in more than ordinary proportions.

2. The presence of sand, clay, and vegetable matter in a soil, is deemed indispensable to all crops ; and lime, in some of its forms, is considered indispensable to wheat, and perhaps some other crops, and prejudicial to none, where it is in moderate quantity.

3. The presence of sand and clay is readily detected by the experienced eye ; that of vegetable matter by the consistence and color of the soil ; and that of carbonate of lime, or calcareous earth, by drying a portion of soil, and pouring upon it some acid, as the muriatic, or even strong vinegar. If it contain any considerable portion of carbonate of lime, effervescence will take place, and the carbonic acid be expelled by the application. The proportions in the elements of a soil are ascertained by chemical analysis.

4. Sand is the most essential in the earthy ingredients of soils, and most predominates in them, though where it exceeds eighty-two per cent. the soil is virtually barren, for it is then too porous to retain long either moisture or manure. Clay is next in importance and proportion ; but when it greatly preponderates, the soil becomes stubborn, is hard to be worked, is too retentive of moisture, too impervious to atmospheric influence, and is more or less unproductive.

Lime exists in the smallest proportion, and is least essential of the three common earths, and from two to four per cent. of the upper tillable stratum is all that is deemed essential to the growth and maturity of any crop. When lime is in excess it induces barrenness, though calcareous soils are considered conducive to the health of the neigh-

borhood, imbibing or neutralizing, like chlorine, the impurities of the atmosphere. Organic matter, that is, vegetable or animal, is indispensable in a soil. It is the food of plants. Yet even this is often found in excess, as in peat, and in too highly manured grounds, and is often insoluble, or infertile, till mixed with larger portions of earthy matters, or brought in contact with fermenting materials.

5. When there is perceived to be a deficiency of sand, of clay, or lime in a soil, the defect may be remedied, and permanent improvement effected, by an admixture of the deficient element or elements. When there is an excess of either, it can only be remedied by a similar but more tedious process. Thus a load of clay, properly blended with an arid sand,—or a load of sand mixed with a stubborn clay, or a few bushels of mild lime, or marl, or ashes, upon a soil deficient in calcareous earth, often prove of more ultimate service than a load of barn-yard manure. But,

6. Both lime and dung, the latter in far the greatest proportion, are taken up and consumed by the growing crop; and if the crops are not consumed upon the field, so that their principal elements return again directly to the soil, the land must be periodically replenished with them, or it will soon become deficient in these elements of fertility.

7. The sand and clay of the soil may be likened, in their offices, to the stomach of the animal—the recipient of food; the lime and salts to the gastric juices, which facilitate the digestive process in the animal stomach, and to the condiments, as salt, &c., which we employ to stimulate the digestive organs and promote health; and the organic matters in the soil to the food which feeds and fattens the animal.

8. If the crops grown upon a soil are permitted to decay upon, and return again to it, its fertility will not be diminished, but rather improved. It is upon this principle that the Flemings have converted sterile lands into fertile ones. They plant the larch, and in a few years the soil becomes so enriched by the foliage of the trees, as to afford, after the wood is cleared off, tolerable crops, and

the nucleus of greater improvement. But when the crop is carried off, and nothing returned, deterioration must take place—the food for the vegetables must undergo a continual diminution. This is a plain exposition of the cause of lands' *wearing out*; and at the same time of the means of preventing their wearing out.

9. All the elements of a good soil being present, its fertility, and consequent profit, will in a measure depend upon its exemption from an excess of water, which, like fire, is a good servant, but a bad master. This excess may arise from spouts and springs bursting up from below,—from surface-waters, where the ground is level, or nearly so, settling and reposing upon a tenacious soil or subsoil, or from waters flowing from higher grounds. Hence the importance of draining. We do not know of any farm-crop which thrives upon a soil habitually wet, either upon the surface, or within the natural range of the roots. Water meadows and rice grounds profit by periodical floodings, but they are injured by habitual wetness.

10. Fertility depends much, also, upon the quality and properties of the subsoil. If this is bad, or comes too near the surface, its faults may be corrected by furrow-draining, and the trench or subsoil plough, or by bringing it up, in small portions at a time, or during a course of crops, to the ameliorating influence of the atmosphere, and incorporating it with the upper stratum, or proper soil.

11. If a soil, under good management, does not return good crops, or if the crops are found annually to diminish, it is a sure indication that there is a deficiency in some of the primary elements of a good soil, that the subsoil has a malign influence, or that there is an excess of water. It is the province of the manager to seek out the cause of the evil, and to apply the proper remedy, be it lime, manure, drainage, or deeper tilth. In doing this, a knowledge of natural science will be found of great advantage.

12. The small-grain crops are the greatest exhausters of the fertility of the soil, on account of their narrow system of leaves, which draw sparingly from the atmosphere, and the large portion of nutriment they extract from it to

mature their seeds. The remark extends to the narrow-leaved grasses, converted into hay, when they are permitted to ripen their seeds in the field.

13. Indian corn, tobacco, and beans may be embraced in the second class of exhausting crops ; for, although they have broad leaves, and derive much nourishment from the atmosphere, they are nevertheless gross feeders, bulky crops, and leave very little upon the soil to compensate for what they take from it. But great economy in dung may be effected by feeding these crops with the long manure of the yards and stables, instead of summer-yarding it, as many farmers are wont to do. These crops will feed upon what is otherwise lost in the yard,—the gaseous matters of the dung. These afford exactly what the crops named want, and at the time they want it.

14. Roots come next in the order of exhausting crops ; but they in part compensate for what they take from the soil by the ameliorating influence they have upon it, pulverizing and freeing it from weeds—by their roots and the culture they demand.

15. Green crops, that is, clover, buckwheat, rye, oats, turnips, and even weeds before they seed, *ploughed under as food for plants in their green, succulent state*, are enriching crops, and powerful auxiliaries in keeping up the fertility of the farm ; but they are too seldom resorted to for this purpose.

16. Depasturing with cattle, and particularly with sheep, enriches a soil. According to Von Thâer, it adds 20 per cent. to the fertility of an ordinary soil, that is, in five years it will double its fecundity. This results from the fact, that the crop is returned to the soil in the droppings and stale of the animals which crop it.

17. Not only do different crops tend to exhaust different properties of the soil, denominated their specific food—but different crops, in consequence of their different systems of roots, draw their food from different portions of the soil : the fibrous-rooted from near the surface, and the tap-rooted from below, and partially from the sub-soil, into which a portion of the humus is carried down by the rains, and into which the tap-roots penetrate to obtain it.

18. Lime and clay are essential in a wheat soil. Indian corn delights in a rich, dry, sandy loam, and makes a good return on light sands, provided it is well fed, that is, well dunged. Turnips excel on dry, sandy soils, though ruta бага requires that they be rich. Barley does best on loams in which there is considerable clay, as do the beet and pea. Oats and potatoes find a congenial home in rich, moist grounds, though for the latter the surface stratum should be light and mellow. Of the grasses, the tap-rooted, as the clover, lucerne, &c. require a deep soil, permeable to their roots, and free from water; the fibrous-rooted, as the tall oat, orchard-grass, &c. thrive upon soils that are dry and shallow; and the rough-stalked meadow, bent, and some of the festuca and agrostis families, are congenial to, and often natural in, moist or swampy grounds. The timothy, the herds-grass of the Eastern states, our main dependance for winter forage, adapts its habits, it is said, to its location—being fibrous-rooted upon dry, and bulbous-rooted upon moist grounds—and therefore suited to either.

19. The natural fertility of a farm cannot ordinarily be kept up, or increased, where arable and mixed husbandry prevail, from the resources of the farm and cattle, without a resort to an alternation or change of crops. Although the diminution of fertility may be imperceptible for a time,—and although some soils seem naturally and peculiarly adapted to certain crops,—yet the stock of humus or of specific food is constantly diminishing, and will ultimately fail, if the same crop, or class of crops, is grown upon the same ground in successive years. Whether, according to the theory of De Candolla and Malcaire, the excrementitious matter thrown into the soil by the growing crop is poisonous to its species; or whether, as we maintain, each species requires and exhausts, wholly or partially, a specific food in the soil, suited to its particular wants,—we will not stop now to inquire; but it is a fact established by general experience, that an annual change of crops upon a field, while under tillage, tends very much to economize its fertility, and to increase the profits of the labor bestowed upon it. Hence,

20. It has been laid down as a sound rule in farming, that two white, or grain, or culmiferous crops, should not be made to succeed each other in the same field ; but that each of these should be alternated with, or preceded and followed by, a green, a grass, a root, or a leguminous crop.

21. Where the soil of a farm will admit of it, a good course is to alternate,—1. roots or Indian corn, with long manure upon the sod ; 2. grain, with grass-seeds ; 3. grass for two years ; or, grass one year ; 4. grain and grass-seeds upon the first furrow ; and, 5. and 6. meadow and pasture. The poorer, or more sandy the soil, the oftener should it be returned to grass, particularly to clover and pasture.

22. Geologists refer to three distinct formations, as constituting the crust of the earth—the *primitive*, as containing little lime and no organic remains ; the *transition*, containing lime and organic remains ; and the *secondary*, abounding extensively in both these elements of fertility. Their natural relative fertility is in the reverse order in which they are named, the secondary being best, and embracing most of the great basin of the Mississippi, and the country drained by its tributary streams. We say nothing of alluvial formations, made by the ocean and rivers. These deposits partake of the character of the country from whence they are brought, and are more or less fertile, according to the fertility of the districts from which their soil is derived, and the force of the currents by which the deposits have been made,—a rapid current leaving only the coarser and heavier materials, while the finer and richer matters subside where the current is slow and less agitated.

23. The three great formations which we have mentioned, possess, it is well known, characteristics differing from each other. They grow, naturally, many plants peculiar to each, and they are adapted to different branches of husbandry, and to different farm-crops. The primitive will not generally grow good wheat ; but is suited to grass, oats, potatoes, &c. The transition is adapted to natural grasses, and to most of the arable crops, particularly to the cereal class ; and the secondary

to the cultivated grasses, to roots, and particularly to wheat.\*

24. There are other circumstances, in regard to the location of a farm, which demand the consideration of the master, which refer to latitude and elevation. Plants have their natural zone, or climate, beyond which they do not grow, or thrive but imperfectly. There is a difference in every degree, or seventy miles, of latitude, upon tide-water, of five or six days, in the forwardness of natural vegetation in the spring, and nearly a like difference in the blighting indications of autumn. But what is of equal importance, but less generally regarded, is the difference in climate produced by altitude. Three hundred feet of elevation is considered equal to one degree of latitude, in its influence upon temperature. Hence it does not follow, that because a crop will thrive and ripen in a given latitude upon tide-water, it will thrive and ripen well in the same latitude at a higher elevation. On the contrary, to be better understood, we say, that, other things being alike, the climate on tide-water, in latitude  $42^{\circ}$ , is similar to that of a place three hundred feet elevated above tide-water in latitude  $41^{\circ}$ , or of a place nine hundred feet above tide-water in latitude  $39^{\circ}$ ; so that the table-land of Mexico, in latitude  $16^{\circ}$ , at an elevation of seven thousand eight hundred feet above the ocean,

\* An able writer in the Edinburgh Quarterly Journal of Agriculture, in reference to these formations, terms the primitive, which it seems comprises the most elevated lands in Scotland, the region of heath and coarse herbage; the transition, the natural region of the grasses; and the secondary, the region of the cultivated grasses, and particularly adapted to arable and alternate husbandry. He assigns to each a particular and distinct breed of cattle. To the first, or higher region, a thick-haired, small, hardy breed; to the second, or middle region, those of large size; and to the third, or lower region, those that are more sensitive to cold, gross feeders, and that acquire the greatest weight. He then goes on to show, from numerous examples, that the several breeds are the most profitable in the several districts assigned them; and that they have been manifestly improved, in most cases, by a judicious cross with the improved short horns. There is much good sense in the writer's remarks; and although the description of the three formations does not fully apply in the United States, the remarks as to the influence of altitude or climate, upon different breeds of domestic animals, are entitled to high consideration.

should possess about the same mean temperature, and produce the same natural and artificial growth, as Kingston, upon the Hudson, though the extremes, both of heat and cold, are probably greater at the northern than they are at the southern point.\* These data are assumed from recollection, and may not be precisely correct.

25. The means of preserving, and of augmenting, the fertility of the soil, are sufficiently indicated in the preceding suggestions. They consist mainly in manuring,

\* "All the western part of the intendency of Vera Cruz," says Humboldt, in his *New Spain*, "forms the declivity of the Cordilleras of Anahuac. In the space of a day, the inhabitants descend from the regions of eternal snow to the plains in the vicinity of the sea, where the most suffocating heat prevails. The admirable order with which different tribes of vegetables rise one above another, by strata as it were, is nowhere more perceptible than in ascending from the port of Vera Cruz to the table-land of Perote. We see there the physiognomy of the country, the aspect of the sky, the form of plants, the figures of animals, the manners of the inhabitants, and the kind of cultivation followed by them, assume a different appearance at every step of our progress.

"As we ascend, Nature appears gradually less animated, the beauty of the vegetable forms diminishes, the shoots become less succulent, and the flowers less colored. The aspect of the Mexican oak quiets the alarms of a traveller newly landed at Vera Cruz. Its presence demonstrates to him that he has left behind him the zone so justly dreaded by the people of the north, under which the yellow fever exercises its ravages in New Spain. This inferior limit of oaks warns the colonist who inhabits the central table-land how far he may descend towards the coast, without dread of the mortal disease of the *vomito*. Forests of liquid amber, near Xalapa, announce by the freshness of their verdure that this is the elevation at which the clouds, suspended over the ocean, come in contact with the basaltic summits of the Cordilleras. A little higher, near la Bandarila, the nutritive fruit of the banana-tree comes no longer to maturity. In this foggy and cold region, therefore, want spurs on the Indian to labor, and excites his industry. At the height of San Miguel, pines begin to mingle with the oaks, which are found by the traveller as high as the elevated plains of Perote, where he beholds the delightful aspect of fields sown with wheat. Eight hundred metres higher, (two thousand six hundred feet,) the coldness of the climate will no longer admit of the vegetation of oaks; and pines alone cover the rock, whose summits enter the zone of eternal snow. Thus in a few hours the naturalist, in this miraculous country, ascends the whole scale of vegetation, from the heliconia and the banana-plant, whose glossy leaves swell out into extraordinary dimensions, to the stunted parachyma of the resinous trees."



draining, the admixture of earthy materials, and the alteration of crops.

26. Stable and fold-yard dung is most profitably applied in an unfermented, or partially fermented state, and to hoed and autumn-ripening crops. Fermentation diminishes the fertilizing properties of manure. If this fermentation takes place in the soil, the gases, the volatile portion which first escapes from the putrefying mass, are retained in the mould, and serve to feed the crop. If fermentation takes place in the yard, or upon the surface, the gases are wasted, and the dung undergoes further loss from the rains which ordinarily leach it. Long manure should be spread broadcast, and well buried by the plough.

27. Short manure, or that which has undergone fermentation, is most beneficial when harrowed in, upon arable lands, or spread upon the surface of grass grounds.

28. Old meadows may be kept in a productive state, in ordinary cases, by a triennial top-dressing with manure or compost; or may be renovated, and restored to a productive state, by the modes recommended in the essay which follows, Chapter XXI.

29. Composts are economical, when made to absorb fertilizing liquids which would otherwise be wasted—or to decompose inert vegetable matter, as peat-earth, &c.

30. Lime, gypsum, marl, and ashes are powerful auxiliaries, when applied to proper soils, or suitable crops. Observation and experience will be the best guides in their application. They should all be applied to the surface, or but superficially covered.

31. All vegetable and animal matters constitute the food of plants, when they are rendered soluble, or capable of being dissolved in the water of the soil.

32. Bone-dust, horn-shavings, poudrette, woollen rags, urine, and animal carbon, or burnt bones, are concentrated manures, and should be used sparingly and with great care, upon or near the surface of the soil. Pigeons' and hens' dung partake much of the character of the preceding, and require precaution in their use. We think the best mode of applying the two first named, is to mix ashes

with them, or long manure, just before they are put upon the soil, whereby they are brought speedily into a state of fermentation and decomposition.

33. The best guards against drought, are keeping the soil deep, rich, clean, and mellow on the surface.

34. The more cattle that are well kept upon a farm, the more manure ; the more manure there is applied, the greater the product and the profit, and the greater the means of sustaining an increased stock of animals upon it. All of these advantages are increased when root crops are made to enter largely into the system of culture.

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## CHAPTER XXI.

### ON THE IMPROVEMENT OF GRASS LANDS.

ALTHOUGH the alternation of grass and grain crops, in connexion with the rearing of cattle, is deemed most profitable, on soils and in situations which will admit of this kind of husbandry, yet there are many situations in which this alternate change cannot be carried into effect without manifest prejudice to the interests of the cultivator. There are some soils so natural to grass, as to yield an undiminished product for many years, almost without labor or expense. There are others, upon the banks of streams, which periodically overflow, which it is prudent to keep in grass, lest the soil should be worn away by the rapid flow of waters. Besides, fertility is kept up upon these last, by the annual deposit of enriching materials. Others, again, are too precipitous, or too strong, to admit of arable culture. Nor should we conceal the fact, that it is still a controverted point, whether rich, stiff clays are not most profitable, when permanently appropriated to grass. Whatever causes prevail, the fact is indisputable, that a considerable portion of our lands is, and will continue to remain, in meadow and pasture. It is with the view to aid the farmer in correcting the defects which may exist in such grounds, and in improving and keeping

them in condition, that we offer the following suggestions. And, first,

### § 1. *Of Pastures.*

The evils that are experienced in pasture grounds, are, the gradual disappearance of the best grasses ; the growth of mosses and weeds in their stead ; and the prevalence of coarse herbage, which cattle reject, in situations where there exists a superabundance of moisture. Wherever there are stagnant waters, as upon flat surfaces that abound in springs, or which have a superficial soil upon a tenacious subsoil, the herbage is not only mainly rejected by the stock, but the pasture is unhealthy, particularly to sheep ; but it is remarked, that if the water is in continued motion, as is generally the case upon the declivities of hills and mountains, ill consequences do not so often result.

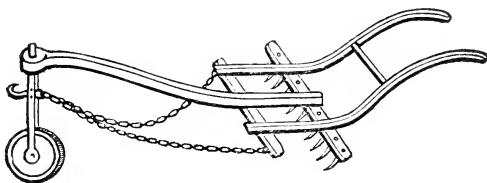
To remedy the evils we have enumerated, and to improve the value of pasture grounds, one or more of the following expedients may be resorted to, viz., sowing and harrowing in grass-seeds, scarifying, bushing, draining, manuring, top-dressing with marl, lime, or ashes.

Grass-seed may be sown either in September or April, followed by the harrow, and, if practicable, by the roller. The harrow partially extirpates the mosses, breaks and pulverizes the surface, and buries the seeds ; and the roller presses the earth to the seeds, and smooths the surface. The bush harrow is to be preferred. This may be constructed by interweaving some strong, but pliant branches of trees through the open squares of a heavy harrow, which thus forms an efficient brush, and when drawn over the ground performs its duty perfectly during a short distance ; but the branches, being pressed close, and worn by the motion, soon become so flat as not to have the effect of spreading the earth thrown upon the surface by earth-worms, ground-mice, or ants. It is therefore recommended, in 'British Husbandry,' as a better mode, to fix the branches upright in a frame, placed in the front part of the carriage of the roller ; by which means they can be so placed as to sweep the ground effectually, and when

worn, can be moved a little lower down, so as to continue the work with regularity. This operation also completely breaks and scatters the manure dropped on the field by the stock, and particularly incorporates it with the surface-mould.

Scarifying is cutting the sod and loosening the surface. Concklin's press-harrow (fig. 34) is a suitable implement for this purpose. We also subjoin the drawing of an implement constructed for this purpose, which we take from 'British Husbandry,' calculated to be drawn by a one or two-horse team.

Fig. 40.



This implement is intended to cut the sod perpendicularly so far down as to sever the roots of the grass, which occasions it to throw out fresh roots. It slices the sod, without tearing it, and should be constructed with a number of very sharp coulter, fixed into a cross-beam at such distances as may be thought advisable, from six inches to a foot, and of a width according to the strength intended to be employed in drawing it. The blades should be occasionally whetted to preserve their edge, and the implement should be used when the ground is in a moderate state of moisture, and the grass short. If the land is poor, or moss-bound, it may be passed crosswise also. It is best adapted to moist clays, which do not contain stones or gravel. It is advantageously used to precede the sowing of grass-seeds. The foot-wheel is to regulate the depth of the work.

Draining improves the quality of the herbage, and marling, liming, or ashing increases the quantity. It is remarked, that animal dung, when dropped on coarse

pastures, produces little or no benefit ; but when calcareous matters have been laid upon the surface, the finer grasses soon take possession of it.

Bushing, that is, drawing over the ground tops or heavy branches of trees, tends to extirpate moss, loosens the surface to atmospheric influence, and covers grass-seeds which may be sown previous to the operation.

Manures are seldom applied to pastures, especially with us ; but, applied in the form of compost, as a top-dressing, they are decidedly serviceable. Gypsum and spent ashes may be applied with undoubted benefit in most cases. Upland pastures have been greatly improved in Scotland, according to Sinclair, by drawing surface-drains diagonally across the face of the hills. The herbage is rendered more palatable and wholesome, and the waters are prevented from accumulating so as to cut gullies and chasms in the hill-sides.

It need hardly be added, that bushes, thistles, and other perennial weeds obstruct the growth of grass, and that they ought to be carefully extirpated ; and that surface stones diminish the herbage in proportion to the extent of surface which they occupy. These, then, should be converted into walls, one of the most economical fences, if well laid, because the most permanent, that can be constructed. The weeds that infest pasture grounds are mostly biennials or perennials. If these are cut two or three times in a season, at the surface of the ground, they will die. Leaves are as essential to vegetable, as lungs are to animal life. Divested of these elaborating organs, the vitality of the vegetable is soon destroyed.

Our pasture grounds are generally left to take care of themselves ; but there is no doubt that expense bestowed upon their improvement, in some of the modes above suggested, would be profitably laid out. Their value depends upon the quality and quantity of the herbage which they afford. The quality is in a great measure determined by the exemption of the soil from stagnant waters, the quantity by the richness of the soil, and its exemption from moss, bushes, weeds, stones, and other surface obstructions ; for if these are eradicated or re-

moved, it is presumed the nutritious grasses will occupy their places.

### § 2. *Of Meadows.*

The crop being here annually carried off, it becomes a matter of necessity, if the field is to be kept permanently in grass, to apply manure occasionally, if we would prevent a diminution of product. It is affirmed, that a perfectly thick bottom cannot be maintained on permanent meadows, in England, unless it is manured every second year. Gypsum will effect much here, upon dry soils, though there its effects are equivocal; but gypsum alone will not suffice here. The average product upon our old grass lands will hardly exceed a ton and a half an acre. With a biennial or triennial top-dressing of dung or compost, where the sod is in good condition, it is believed the average would be double.

Meadows are subject to all the evils that are experienced in pastures, from mosses, wetness, and the diminution of the finer grasses, besides the greater exhaustion of fertility consequent upon carrying off the annual growth; and the same measures are best adapted to renovate them. Meadows are generally depastured after the hay has been taken off, and the rowen partially grown. "After the cattle have been removed," says an English writer, "the land is *bush-harrowed* and *rolled*." It has been stated, though some question the fairness of the experiment, that the operation of heavy rolling has been found to add six or seven hundred weight of hay per acre to the produce of the crop.\*

The effect of pasturing meadows in the spring, upon the coming grass crop, has been a matter upon which farmers have differed—though all agree that heavy cattle should not be kept on so late in autumn, or put on so early in spring, as to injure the sole of the sod, by poaching it when in a wet state. Mr. Sinclair has stated, that a given space of the same quality of grass having been cut towards the end of March, and another space of equal size left uncut until the last week in April, the pro-

\* Derbyshire Report, vol. ii. p. 88.

duce of each having afterwards been taken at three different cuttings, that of the space last cut exceeded the former in the proportion of three to two ; and in one instance, during a dry summer, the last-cropped space exceeded the other as nearly two to one.\* It is generally conceded, that it is better to feed off rowen, than to cut it as a second crop.

But when grass grounds can be alternated with arable crops, and where they are not periodically overflowed, or triennially dressed with compost or manure, we are decidedly of opinion that they should be subjected to the alternating system. A field well laid down in seeds, will give more grass the two first seasons, or in the three seasons following, than it will in the four seasons following these, unless it is overflowed, manured, or top-dressed. Besides, the grass ley, if turned under, greatly enriches the soil for a tillage crop ;—which, by its ameliorating tendency, in pulverizing, opening it to atmospheric influence, and exposing a new surface, fits the soil again for the return of the grasses. But the mere alternation of crops tends to preserve the fertility of the soil.

A great objection to the alternating system on clay grounds is, that it is difficult to make the grass-seeds take, the spring and autumn being generally too wet to obtain so complete a pulverization of the soil as will fit it for the reception of grass-seeds,—and of course, if sown then, they do not germinate and grow. Judge Van Bergen, of Greene County, New York, has adopted a practice which obviates these objections. He sows his grass-seeds with buckwheat, at midsummer, when the ground can be well worked. We have seen his fields, a stiff clay, of one, two, and three years' seeding, as well set with grass as we have seen on the most favored soils ; and, compared with adjoining meadows which had not been broken up, the crop was at least double.

Where old grass-grounds are to be broken up, other than for a summer fallow, the first ploughing should be in autumn, in order that the vegetable matters of the sod may

\* Woburn Grasses, p. 389.

undergo a partial decomposition in time to meet the wants of the spring crop, and that the soil may be exposed to the ameliorating influence of the winter frosts.

Paring and burning, upon clay soils, would be of manifest advantage, not only in converting the sod speedily into soluble matters, but in improving the condition of the soil itself. We long entertained a prejudice against this mode of improvement, on the ground that it destroyed much of the food of plants; but we have been induced, in a measure, to change our opinion, from a conviction, that the food of plants is not annihilated, but rather concentrated, changed in its form, and rendered more available to the crop. This is seen in burning new fallows. Paring and burning produce a further benefit by destroying most of the seeds and roots of noxious or useless plants.

“The objections to the division of a farm,” says Sir John Sinclair, “one half into *permanent grass*, and the other half into *permanent tillage*, are not to be surmounted. The arable is deteriorated by the abstraction of the manure it produced, if applied to enrich the grass; while the greater part of the manure thus employed is wasted; for spreading putrescent substances upon the surface of a field, is to manure, not the soil, but the atmosphere; and is justly condemned as the most injurious plan that can be devised in an arable district. The miserable crops of corn produced where this system prevails sufficiently prove its mischievous consequences. So injurious is this mode of management, that, in the opinion of the most intelligent farmers, the landlord loses one fourth of the rent he might otherwise have got, from every acre thus debarred from cultivation, while the public loses  $3\frac{3}{4}$  bushels of grain for every stone (14 lbs.) of beef or mutton thereby obtained.”

The complaint of the inferiority of the new over the old pasture herbage, originates, says Sinclair, either from the improper choice of seeds, or from giving them in too small quantities; and he quotes the example of an eminent farmer, upon a clay farm, who stocked heavy with grass-seeds, and who always secured a thick coat of her-



bage the first year, which differed from old pasture *only in being more luxuriant*. There can be but little doubt, that grasses will grow more luxuriantly in a soil which has been recently meliorated by the plough and harrow, than in one which has remained undisturbed for years. The great difficulty is in getting the ground into proper condition to receive the seeds, and in getting them to *begin* to grow.

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## CHAPTER XXII.

### ON THE CULTIVATION OF GRASSES.

ON the judicious selection and proper cultivation of grasses, materially depend the profits of the farmer. These constitute, directly, the principal food of his farm-stock; and, indirectly, the food of his crops. If his grasses are abundant and nutritious, a greater number of domestic animals may be maintained, and the greater will be the returns they will make to the soil, in manure. A well-set sward is far more enriching to the soil, because it contains much more organic or vegetable matter, the food of plants, when ploughed under, than one that is thin and meager. A judicious selection comprises those kinds which are naturally best adapted to the soil. A proper cultivation consists in keeping them free from stagnant water, noxious weeds, and, if to remain long in meadow, in giving them a triennial top-dressing of manure or compost. One acre of good grass will cut three tons of hay, or keep a cow, or, if in lucerne, will soil half a dozen cows five months in a year. Four acres of lean, poor grass will cut little more, if any, than three tons of hay, and will barely suffice to keep a cow. There is as much difference between good and bad grass lands, in regard to profit, as there is between a good and a bad field of corn or wheat.

The common practice in this branch of husbandry has hitherto been wretchedly bad. Generally, and until lately, we have either altogether omitted to sow grass-seeds,

or have sown them so sparingly, or of so few kinds, that we have in a great measure lost much of the profit which they are calculated to afford. Timothy and red clover have been almost the only seeds sown; and unless the soil has been prolific in indigenous kinds, our pastures have been thin, and our meadows light. There is one fact in regard to grasses which is not sufficiently known and appreciated. Different species subsist upon different specific properties of the soil, and draw their food from different strata, the fibrous-rooted gathering sustenance from the upper, and the tap-rooted from the lower stratum. And it has been found, that although a superficial square foot of turf will only support a given number of plants of one species, it will nevertheless support double or treble that number of plants comprising several species.

We mean, by cultivated grasses, those of which the seeds are sown by the husbandman, whether indigenous, or natural to the soil, or exotic. And in discussing the subject, we shall consider them under two heads, and shall draw liberally for facts and illustrations from Loudon and other approved agricultural writers. The divisions we propose are,—

1. Herbage plants, or those particularly fitted for alternate husbandry.
2. Cultivated grasses, or those best adapted for meadow and pasture.

### § 1. *Herbage Plants.*

Under this head, Loudon has embraced the clovers, lucerne, sainfoin, birdsfoot trefoil, parsley, burnet, ribwort, plantain, broom, wall-flower, yarrow, &c. The six last are never cultivated among us as herbage or field plants; the sainfoin, which is peculiarly adapted to chalk soils, has never been successfully cultivated among us, and the birdsfoot trefoil but partially. We shall therefore confine our remarks, in this department, to the clovers and lucerne.

The cultivation of clovers and lucerne exclusively for live stock, is comparatively a modern improvement in

husbandry. These plants were not introduced into British husbandry until the sixteenth century. Their introduction among us, on any thing like a general scale, was far more recent. Indeed, lucerne has hardly yet obtained a footing among us ; and a great many of our farmers are yet strangers to the great advantages which the cultivation of the clovers imparts to farming operations.

In Flanders, where husbandry underwent its earliest improvements after the feudal age, and where it is found now most to excel, the cultivation of clovers is deemed indispensable to profitable farming. It forms a part of the course in every system of rotation upon all soils that will grow it. Upon their cultivation, says Radcliffe, hinges apparently the whole of the farmer's prosperity. "Without clover, no man in Flanders would pretend to call himself a farmer." Clover is used there as it should be used here—both to feed the animal and to enrich the soil. In Great Britain, clovers are considered alike indispensable to good farming, particularly upon sandy and other light lands. Their general introduction into American husbandry promises higher advantages than have been derived from them in Europe, inasmuch as gypsum, which exerts a magic influence in their growth, produces a more uniformly beneficial effect in the United States than it does in Europe, excepting perhaps in the interior of Germany. Those districts in our country in which clover and plaster were first introduced, as some of the counties in the valley of the Hudson, and on the eastern border of Pennsylvania, have unquestionably made the most rapid strides in agricultural improvement, and are now confessedly, and by far, the best-cultivated districts of our country. Those who have followed their example, in whatever part of the country they have been located, are realizing a rich reward for their intelligence and enterprise. Several counties might be named, which have doubled their agricultural products, and the profits of their agricultural labor, since the introduction of clovers and gypsum. No thorough-going farmer, we believe, who has given them a fair experiment, has voluntarily given them up.

The species of clover in cultivation are—

1. The common red clover, (*Trifolium pratense*,) a biennial, and sometimes, if not permitted to seed, a triennial, known from the other species by its broad leaves, luxuriant growth, and reddish purple flowers.

2. The white, or creeping, or Dutch clover, (*T. repens*,) is a perennial plant, known by its creeping stems and white flowers; and springing up, it would seem, almost spontaneously, in most of our pastures and meadows.

3. The yellow clover, hop-trefoil, or shamrock clover, (*T. procumbens*,) a biennial, known by its procumbent shoots, yellow flowers, and black seeds. This species is not cultivated among us, though it seems to abound in the northern and middle States.

4. The cow-grass, meadow clover, or marl-grass, (*T. medium* of Linnæus, and resembling, says Beck, the *T. Pennsylvanicum* of Wild,) is a perennial, resembling the red clover, but of a paler hue, dwarfer habit, with pale red or whitish flowers, and long roots, very sweet to the taste. Whether what we term *Southern Clover* is the *T. medium*, or *T. Pennsylvanicum*, or a variety of the *T. pratense*, we shall leave it to botanists to settle, barely remarking, that its time of flowering is usually ten to fourteen days earlier than that of the northern red clover.

5. Scarlet clover, (*T. incarnatum*,) an annual, a native of Italy, but little known or cultivated either in the United States or Great Britain. We have sown it twice on a limited scale; and although it promised a handsome product, it did not attain its growth in time for a forage crop, or to mature its seeds.

Of the species we have named, the *pratense*, *repens*, and *medium*, if the latter be a distinct species, are the only ones which are, or are likely to be, cultivated among us. The first yields the heaviest burden, but is coarser, and later in maturing than the last named; and the latter has consequently one manifest advantage over the former,—it will give two crops in a season, one to the scythe, and one for seed. It is to be remarked, that the first growth or crop of clover seldom produces much seed, on account of the heat of our mid-summer. If the first

crop of the large clover is not cut until it is in full blossom, the season hardly suffices for a second crop to mature its seed. The southern clover may be fed till the 20th June, or the first crop taken by the 25th or 28th, and the second or seed crop will come to perfect maturity, in ordinary seasons, before the autumnal frosts. The white clover is not sown to the extent it deserves to be. Being a perennial plant, and grateful to all kinds of farm-stock, its continuance in meadow and pasture grounds renders it highly valuable, both for hay and grazing. It does not seem to intrude upon the taller grasses, but will occupy every vacant space, and add essentially to the value of the crop. It is universally valued and admired; then why not sow it more generally?

The soil best adapted to the growth of red clover, (*T. pratense* and *T. medium*,) to which we shall hereafter confine our remarks, is a deep, sandy loam, or other soils which will admit freely the long tap-roots to extend downwards; but they will grow in any soil, provided it be dry. Calcareous soils are also peculiarly congenial to clover; and the application of gypsum upon soils sensitive to its influence, will call into action the seeds, which before would seem to have lain dormant, for want of this stimulus, or specific food.

The usual time of sowing clover-seed is in the spring, if with a spring crop, before the last harrowing; or upon winter grain in March or April, when the field will bear cattle without poaching the ground, followed by a light harrow or roller. Let no one fear to injure his grain by harrowing it in the spring. The harrow or roller effects a material benefit, by breaking the crust which is generally perceptible on the appearance of dry weather, in the spring, closing the innumerable cracks which are caused by the contraction of the soil, and in pressing down, and even covering the crowns of the plants. Harrowing winter grain in the spring has long been a general practice in the north of Germany, and the practice would not have been persisted in had it not been found beneficial. Clover-seeds are sometimes sown with the autumn crop, in September or October; though this practice is not to be

approved of, as the plants do not ordinarily obtain sufficient strength to withstand the severity of our northern winters. A better practice would be, we think, to sow with buckwheat in July. The plants would then have time to establish themselves well in the soil. We, however, think that spring sowing is to be preferred in the northern States.

The quantity of seed to be sown on an acre, will depend upon the quality of the soil, the purpose to which the clover is to be applied, and the quantity of other grass-seeds sown with it. As much of the seed sown upon stiff clays, or upon grounds not well pulverized, will not vegetate, for want of a continued supply of moisture, allowance should be made for the failure; yet, upon these, and wet grounds, the main dependance, after the first year, is upon timothy or other grasses sown with the clover. If the ground is intended for pasture, the varieties of seeds should be as extensive as possible, as the object is to obtain an abundance of food at all seasons, and to render the pasture perennial. The usual quantity of seed sown on the acre in the United States, is about ten pounds; in Great Britain it is often increased to fourteen pounds; while in Flanders six pounds is the medium quantity, though in the latter country the land is always in the best condition to receive it. The more plants that can be made to grow, the finer will be the herbage, and the greater the amount of vegetable matter afforded by the ley to the crop which is to follow.

The after-culture of clover consists in freeing the surface of stones and sticks, the soil from docks and thistles, and in applying an annual top-dressing of gypsum, or, when this is inoperative, of lime or ashes. The top-dressing is best applied in the spring, before the clover begins to grow. Upon lands annually dressed with plaster, a bushel is considered a sufficient dressing for an acre, though greater quantities are often applied with advantage.

The making clover into hay is a process different from that of making hay from natural grasses. All herbage plants abound most in nutriment, and should be cut be-

fore the seeds are formed, and indeed before fully in blossom, that the full juice and nourishment of the plant may be retained in the hay. A crop of clover, when cut in the early part of the season, may be ten per cent. lighter than when it is fully ripe; but the loss is amply counterbalanced, by obtaining an earlier, a more valuable, and more nutritious article; while the next crop will be proportionably more heavy. The hay from old herbage will carry on stock, but it is only hay from young herbage that will fatten them. When the stems of clover become hard and sapless, by being allowed to bring their seeds towards maturity, they are of little more value as provender than an equal quantity of the finer sort of straw.

The mode of making clover hay, as practised by the best farmers, is as follows: The clover is cut close to the ground, in as uniform and perfect a manner as it is possible to accomplish, by the scythe kept constantly sharp. That part of the stem left by the scythe is not only lost, but the after-growth is neither so vigorous nor so weighty as when the first cutting is taken as low as possible.

As soon as the grass is partially wilted, let the swath be gently turned over, but not spread or scattered. This may be done with forks or rakes. If the weather is fair, and the clover cut in the morning, the swaths may be turned after dinner; and if mown after noon they may be turned before evening; at which time those turned after dinner may be put into grasscocks. This last operation should be performed with care, and in this manner:—Three swaths are appropriated to a row of cocks. The laborer gathers a good forkfull, and deposits it on the centre swath, if the ground is dry, if not, in one of the intervals, putting it down gently, so that the cock may present a small base; he then continues to gather and deposit in the same way until the cock is brought to a point, at the height of four to five feet, according to the dryness of the clover,—the dryer this is, the higher the cock may be made. When completed, the grasscock is two to three feet broad at the ground, tapering to the apex, and the projecting ends of the herbage drooping, so

as to carry off the rain which may fall. The points to be regarded are, to cock before the leaves begin to crumble, not to suffer the dew to fall upon the dried surface of the swath, and to build the cocks so as completely to shed rain, should the weather be bad. These grasscocks may stand to advantage 36 or 48 hours, without any prejudice, and should not be opened until there is a fair prospect of obtaining a few hours of good weather to complete the curing process. When this is the case, open the cocks as soon as the dew is off, spread them partially, from four to six inches thick. If the day is good, the spread clover may be turned over between twelve and two, and in an hour or two afterwards be gathered for the barn. By this process of curing, the leaves are all preserved, injury from dew and rain is in a great measure avoided, the stalks are better dried, and the appearance and value of the forage are retained in their highest perfection. If rain is apprehended, after the grasscocks have stood a night, these may be doubled by putting one upon the top of another, and dressing with a rake. An intense sun is almost as prejudicial to clover as rain; and therefore it should not be shaken out, spread, or exposed often than is necessary for its preservation. The more the swath is kept unbroken, the more green and fragrant will be the hay.

The advantage of curing clover in the cock is this, that when cured by being spread, the leaves and blossoms are dry long before the stems are cured, or sufficiently dry; so that either the stems must be housed before they are properly cured, or, if made sufficiently dry by long exposure to the sun, the leaves and blossoms become too dry, crumble, and are lost. If in cock, all parts of the plant dry alike, the moisture in the mass is equalised, and when gathered to the barn, there will scarcely be a leaf lost, while the stalks will be amply cured. A slight fermentation often takes place in the cocks, which, instead of doing any injury, is a benefit, as it prevents the hay from afterwards heating in the mow or stack. It is a good practice to sprinkle salt upon clover hay, when deposited in the barn, especially upon



the first loads brought in, not so much with the view of preserving the hay, as of seasoning it, and rendering it more palatable to the cattle.

The secret of making good hay, says Low, is to prepare it as quickly as possible, and with as little exposure to the weather, and as little waste of the natural juices, as circumstances will allow. When we are enabled to do this the hay will be sweet, fragrant, and of a greenish color.

The produce of clover, on the best soils, is from two to three tons per acre. The difference in quality, resulting from the mode of curing, is apparent from this fact, that well-cured clover, according to Loudon, is generally twenty per cent. higher in the London market than meadow hay, or clover and rye-grass mixed.

As we have before remarked, clover will not perfect its seed in the early part of the season; therefore it is necessary to take off the first growth, either as a hay crop, or by feeding it off, till June, and to depend for the seed upon those heads that are produced in autumn. The product in seed varies from two to five bushels an acre. When ripe, the heads are gathered, with or without the stems, threshed, and the seed separated from the chaff in a clover-seed mill. The seed forms an article of substantial profit with many farmers, and amounts often to more than the rest of the crop. Assuming as an average four bushels to the acre, and estimating it to be worth ten dollars a bushel, the acreable value would be forty dollars. The expense of threshing and cleaning is comparatively trifling. The stems of the seed crop, if cured in the manner directed for clover hay, are of more value as fodder than straw, and constitute excellent litter for the stables and yards.

When we take into consideration the value of the first crop for forage, and of the second crop for seed and litter; and consider, that while clover is one of the least exhausting crops to the soil, it returns more to it than almost any other crop, and benefits it mechanically by pulverizing and dividing it, by its tap-roots;—if we take these several matters into consideration, together with the facts, that clover is admirably adapted to light, sandy

lands, to the alternate system of husbandry, and that its growth is wonderfully accelerated by gypsum—we shall not be surprised at the saying of the Flemings, that “without clover, no man in Flanders would pretend to call himself a farmer ;” nor shall we be surprised at the uniform success which has attended its culture in the United States.

#### LUCERNE—*Medicago sativa*, L.

Lucerne is a deep-rooted perennial plant, sending up numerous small and clover-like shoots, with blue or violet spikes of flowers. It is a native of the south of Europe, is extensively cultivated in the south of Spain, Italy, France, Persia, and Lima, in the two latter being cut all the year round,—and is partially cultivated in Great Britain and the United States. With us it is often called French clover, and is found to be as hardy as red clover. It was extensively cultivated by the Romans, and commended by Columella, as the choicest of all fodder. Three quarters of an acre of it, he thought abundantly sufficient to feed three horses during the whole year.

The soil for lucerne must be dry, friable, inclining to sand, and with a subsoil not inferior to the surface. Unless the subsoil be good, deep, and dry, it is in vain to attempt to cultivate lucerne. A friable, deep, sandy loam is excellent for it. No land is too rich for it.

The preparation of the soil consists in deep ploughing and minute pulverization. Loudon recommends trenching for it. But a good preparation is a potato crop, heavily dressed with long manure, the ground ploughed very deep, and the manure buried at the bottom of the furrow, and the crop kept perfectly free from weeds.

The season most proper for sowing in the northern and eastern States is about the 1st to the 15th of May, when the ground has become sufficiently warmed to promote quick germination.

The manner of sowing lucerne is either broadcast or in drills, and either with or without an accompanying crop. Broadcast, with a very thin cast of winter rye, is most generally preferred in the United States ; though drills, by enabling the cultivator to keep out grasses and weeds,

promise the greatest permanency to the crop. A gentleman, who has sown in drills, three feet apart, and cultivated alternate rows of mangel wurtzel with the lucerne, speaks in high commendation of the practice. Arthur Young recommends drilling at nine inches.

The quantity of seed, when the broadcast method is adopted, is from fifteen to twenty pounds ; in the United States, sixteen pounds is the usual quantity,—and when drilled, eight to twelve pounds suffices. The ground should be perfectly pulverized, the seed put in with a fine harrow, and the operation of sowing finished with the roller.

*The after culture of lucerne*, sown broadcast, consists in harrowing, in the spring, to destroy grass and weeds ; rolling, after harrowing, to smooth the soil for the scythe ; and such occasional top-dressings with gypsum, ashes, or rotted manure, as the plants may require, or the convenience of the farm best afford. The harrowing may commence the second year, and the weeds collected should always be carefully removed. In succeeding years, two harrowings may be applied, one in spring and the other in the latter part of the summer. If in drills the crop must be kept clean by the hoe, cultivator, &c. Liquid manure from the cattle-yard is an excellent manure for this crop.

The taking of lucerne, by mowing, for soiling or hay, or by tethering, hurdling, or pasturing, may be considered the same as for clover. Lucerne frequently attains a sufficient growth for the scythe from the 10th to the 20th May ; and in soils that are favorable for its culture, it will be in a state of readiness for cutting a second time in twenty or twenty-five days, being capable of undergoing the same operation, at nearly similar intervals of time, during the whole of the summer season. In the United States, in a good soil, it may be cut, for soiling, four, and sometimes five times in the season.

The application of lucerne is, with us, generally for the purpose of soiling, with the exception sometimes of the last cutting. It is advantageously fed in its green state to horses, cattle, and hogs ; but as a dry fodder, it is also capable of affording much sustenance, and as an early food for ewes and lambs, may be of great value in par-

ticular cases. All agree in extolling it as food for cows, whether in a green or dried state; and it is said to be much superior to clover, both in increasing the milk and butter, and in improving their flavor. In its green state, care is necessary not to feed too much at a time, especially when moist, as cattle may become hoven or blown with it. It is a good precaution to cut it the day before it is used, and to let it wilt in the swath. When made into hay, lucerne should never be spread from the swath, but managed as directed for clover. It may be housed before perfectly dry, if it is alternated in the mow with layers of straw, which imbibe the superabundant juices, and thereby become grateful and nutritious to the farm-stock, when fed with the lucerne.

Soiling is a term applied to the practice of cutting herbage crops green, for feeding or fattening live stock. On all farms under correct management, a part of this crop is cut green for the working horses, often for milch cows, even when at pasture; and in some instances, both for growing and fattening cattle. On small farms, this crop is of immense advantage, as affording a ready substitute for pasture.

The produce of lucerne, cut three times in a season, has been stated from three to five, and even eight tons per acre. In soiling, one acre is sufficient for five or six cows during the soiling season.\*

\* In the first volume of the *Transactions of the Society for the Promotion of Agriculture, Arts, and Manufactures*, we find a detailed statement of a series of experiments made by the late Chancellor Livingston, in 1791 to 1794, in cultivating lucerne, most of which proved unsuccessful. He sowed it mixed with clover-seeds, and by itself, on a variety of soils, at different seasons, and with oats, wheat, buckwheat, barley, and turnips. These experiments warrant the following conclusions:—That the seeds should be sown on a dry, rich, deep soil, in May, when the earth is sufficiently warm to excite a quick germination and growth; that from 16 to 20 lbs. of seed should be sown on an acre, and the ground harrowed and rolled; that “it is full as hardy as clover,” and “better braves the biting frosts of spring, and keen autumnal blasts, than clover, or any cultivated grass of this climate;” and that the profits of an acre may be estimated from \$20 to \$30 per annum. The following is Chancellor Livingston’s account of the expense and produce of the third year—this experiment being made on the fourth of an acre.

“1st April—manured with ten loads of black earth from a swamp, or at the rate of 40 loads to the acre.

One of our farmers has kept eight cattle (two oxen and six cows) upon an acre of lucerne, during the season, with a range of three or four acres of pasture. Say, however, the produce is equal to a full crop of red clover in value, then, yearly for nine or ten years, (its ordinary duration in a productive state,) at an annual expense of harrowing and rolling, and a triennial expense of top-dressing, it will be of sufficient value to induce farmers, who have suitable soils, to lay down a few acres of this crop near their homesteads.

To save seed, the lucerne may be treated precisely as red clover, i. e., obtained from the second cutting, or even the third, the crop being left to ripen its seed. It is easily threshed, the grains being contained in small pods, which readily separate under the flail, threshing-machine, or clover-mill.

## § 2. *Cultivated Grasses.*

“The forage, hay, and pasture grasses,” says Loudon, “of which we are now about to treat, are found

“It was very luxuriant, and cut twice before the 20th June, for plough-horses, kept in the stable—being, when they began to cut each time, about 16 inches high—the average height, taking the first and last cutting, each time, about 20 inches. On the 24th of July, cut and made into hay, produced 1000 lbs., or two tons to the acre. On the last of August cut a fourth time, produced 600 lbs., or 2400 to the acre. The fifth crop is not cut, but is now, the first of October, 20 inches high, and very promising in its appearance. If we have no severe frosts before the middle of this month, it will produce about 6 cwt. of hay.

### *Produce and Expense of Acre No. 1.*

40 loads of black earth from an adjoining swamp, at 1s.		
per load, . . . . .		£2 00 00
Cutting five crops and making them into hay, at 8s. . . . .		2 00 00
	Tons.	Cwt.
Two first crops, valued at 5 cwt. each, or . . . . .	2	0
Third crop in hay, . . . . .	2	0
Fourth crop do. . . . .	1	4
Fifth, estimated at . . . . .	1	0
	<hr/>	
	6	4
6 tons 4 cwt., at 2s. 6d. . . . .		£15 10 00
Expenses above, . . . . .		4 00 00
Profit, . . . . .		<hr/> £11 10 00

clothing the surface in every zone, attaining generally a greater height, with less closeness at the roots, in warm climates ; and producing a low, close, thick, dark green nutritive herbage, in the cooler latitudes. The best grass pastures are found in countries that have least cold in winter, and no excess of heat in summer, as in Ireland, England, Holland, and Denmark. In every zone, where there are high mountains, there are certain positions between the base and summit, where, from the equilibrium of the temperature, turf may be found equal to that in marine islands."

The universal presence of the forage grasses, and the rapidity with which all soils become covered with them, when left uncultivated, is the obvious reason why their selection and systematic culture are of but recent date. This branch of culture originated in England, about the middle of the seventeenth century, and at first embraced only rye-grass, was afterwards extended to cock's-foot, timothy, foxtail, &c. The Duke of Bedford made the latest and most laborious efforts towards attaining a knowledge of the comparative value of all the British and some foreign grasses worth cultivating. The result is given in the Appendix to Sir H. Davy's *Agricultural Chemistry*, and of which an abstract will be found at the close of this essay.

With respect to the general culture of *grasses*, though no department of agriculture is more simple in the execution, yet, from the nature of grasses, considerable judgment is required in the design. Though grasses abound in every soil and situation, yet all the species do not abound in every soil and situation indifferently. On the contrary, no class of perfect plants are so absolute and unalterable in their choice in this respect. The creeping-rooted and stoloniferous grasses will grow readily on moist soils ; but the fibrous-rooted species, and especially the more delicate upland grasses, require particular attention as to the soil in which they are sown ; for in many soils they will not come up at all, or die away in a few years, and give way to the grasses which would naturally spring up in such a soil, when left to a state of nature.

Hence in sowing down lands for permanent pasture, it is a good method to make choice of those grasses which thrive best in adjoining and similarly-circumstanced pastures for a part of the seed, and to mix with these what are considered the very best kinds.

Although the catalogue of grasses, indigenous and foreign, which are useful for forage, is numerous, yet the number cultivated, or propagated artificially, is very limited, and indeed it is but recently, not perhaps half a century, that we have been in the habit of sowing grass-seeds at all. The practice is however gaining, and it is reasonable to believe, that many species will ere long be advantageously cultivated, which have hitherto altogether escaped the notice of the farmer.

We shall confine our remarks, at present, to those species which are cultivated, upon a broader or less scale, among us. And we begin with that deemed most valuable as a forage grass, at least in the northern States; viz.,

1. *Timothy*, better known in the east as *herds-grass*, and in Europe as *meadow cat's-tail*, (*Phleum pratense*.) This is the general forage grass of the northern States. It finds here a congenial climate, particularly in mountainous districts, is perfectly hardy, perennial, highly nutritious, and gives an abundant product; and it should not escape the notice of the farmer, that it is far more rich in nutritious properties, when cut in the seed, than when cut in the blossom. It is often sown alone, but more generally with clover; though the two are not well conjoined, for the clover is in condition to be cut two weeks before the timothy is in seed. Yet where the grounds are intended to be left a considerable time in grass, the loss is not so material; for the clover gradually disappears, while the timothy enlarges its volume, and fills the ground. Although the crop is less nutritious when cut early, the aftermath compensates, in some measure, for the deficiency; for, if suffered to seed, the after-growth is comparatively trifling, and the exhaustion to the soil is far greater. The maturing of the seeds, of all crops, is what most impairs the fertility of the soil.

Another consideration which renders this grass desirable is the value of the seed which it affords, and which may be saved without materially deteriorating the hay crop. From ten to thirty bushels of seed are taken from an acre by many farmers, in the valley of the Mohawk, and constitute a large item of their farm profits. The seed of this grass being small, particular care is requisite in pulverizing the ground for its reception, and, when practicable, the roller should follow the seeding process. The seed may be sown in autumn with winter grain, in the spring with a crop, or at midsummer with buckwheat. Upon stiff, tenacious clays, the latter practice has been found to be advantageous, unless the season prove unusually dry.

In cutting timothy for seed, the most approved mode is to reap the tops, say twelve inches long, with a sickle, to the width of a swath or two, and then immediately to cut down the stems with a scythe. In this way, all foul seeds may be avoided, and a suitable place provided, as the cutting progresses, to spread and dry the tops.

2. *Red-top*, the *herds-grass* of the middle and southern States, (*Agrostis vulgaris*,) is indigenous, perennial, and valuable for hay and pasture, on lands adapted to its growth, which are reclaimed swamps and other moist grounds, and in which it almost every where springs up and flourishes spontaneously. This grass and timothy are fit for the scythe about the same time, and are therefore very suitable kinds to be sown together. Its cultivation is yet very limited, though of manifest advantage. The seeds are kept for sale in the seed-shops. The *white-top* or *foul meadow* is said, by Muhlenburgh, to be a variety of the *A. vulgaris*.

3. *American Cock's-foot* and *Orchard-grass* are different names given to the *Dactylis glomerata* of botanists. This is one of the most abiding grasses we have. It may be known by its coarse appearance, both of the leaf and seed-spike, its broad leaves, seed-glumes resembling a cock's-foot, and also by its whitish-green hue. It is probably better adapted than any other grass to sow with clover and other seeds for permanent pasture, and for a crop of hay, as it is fit to cut with clover, and grows



remarkably quick after being cropped by cattle. Five or six days' growth in summer suffices to give a good bite. Its good properties consist in its early and rapid growth, and in its resistance of drought ; but all agree, that to obtain its greatest value, it should be kept closely cropped. Sheep, it is said, will pass over every other grass to feed upon it. If suffered to grow long without being cropped, it becomes coarse and harsh. Arthur Young and Mr. Cook commend it highly, and the latter cultivates it on an extensive scale at Holkham. Colonel Powell, of Pennsylvania, after growing it ten years, declares, that it produces more pasturage than any cultivated grass that he has ever seen in America. On being fed very close, it has been found to afford good pasture after remaining five days at rest. It is suitable to all arable soils. It abounds in seed, which is easily gathered ; but, on account of its peculiar lightness, (the bushel not weighing more than twelve or fourteen pounds,) it should be spread on a floor and sprinkled with water a day or two before it is sown, that it may become saturated, and more easily germinate. Two bushels of seed are sown to the acre, when sown alone ; and half this quantity when sown with clover. The orchard-grass should be cut early when intended for hay, as it diminishes two sevenths in value, as hay, by being permitted to ripen its seeds. When cut early with clover, the after-growth, or rowen, is very abundant.

4. *Tall Oat-grass*, (*Avena elatior*.) Dr. Muhlenburgh, and Mr. Taylor, of Virginia, place this at the head of good grasses. "On the continent of Europe," says Dickson, "in comparison with common grass, it is found to yield in the proportion of twenty to two." Dr. Muhlenburgh says, of all others it is the best grass, and earliest for green fodder and hay. The Doctor was probably not advised of its deficiency in nutritive matter, as indicated in the experiments of Sinclair. It possesses the advantage of early, late, and quick growth, for which the orchard-grass is esteemed, and is well calculated for a pasture grass. We have measured it in June, when in blossom, (at the time it should be cut for hay,) and found

the seed-stems four and a half feet long. The latter-math, it will be perceived by the table which is appended, is nearly equal in weight, and superior in nutritious matter, to the seed crop. Sinclair says it thrives best on a strong tenacious clay ; and Muhlenburgh prefers for it a clover soil. Dickson speaks well of it, and says it makes good hay, but is most beneficial when retained in a close state of feeding. The seed falls and wastes unless gathered early, and with care. Sow at the rate of six or eight pecks the acre, with grain, in the spring.

5. *Sweet-scented Vernal Grass* (*Anthoxanthum odoratum*) is a foreign perennial grass, of dwarfish habit, sown principally on grounds intended for pastures, for the very early feed which it affords, and for its growing quick after being cropped. Muhlenburgh says it delights in moist soils ; the ' Bath Papers ' assure us it does well in clayey loams ; and Dickson, that it grows in almost any soil, including sands and bogs. It is eaten by oxen, horses, and sheep, though not so freely as some other grasses are.

6. *Meadow Foxtail* (*Alopecurus pratensis*) is also a foreign grass, possesses all the advantages of early growth with the preceding, and is much more abundant in produce and nutriment, but is not so well suited to different soils. It almost invariably constitutes one of the several seeds which are sown together by the British farmer, particularly when the grounds are intended for pasture. " Of all the English grasses," says Dickson, " this appears to be the best adapted for cutting twice. It starts up very rapidly after mowing or feeding, and produces an abundant aftermath." It does best in moist soils, whether loams, or clays, or reclaimed swamps. It abides nine or ten years. Sheep and horses have a better relish for it, according to G. Sinclair, than oxen. It abounds in seed, says Middleton, which is easily collected from the swath during mowing time.

The two preceding grasses were probably introduced first some years ago, into the neighborhoods of Boston, New York, Philadelphia, &c., by emigrants, or others ; and as they seed earlier than the orchard-grass or tall oat, and before they would be likely to be cut for hay, the

seeds have probably been scattered, and these grasses are now found in those neighborhoods, among the natural grasses of the meadows. A great advantage resulting from sowing these seeds, as also of the orchard and tall meadow-oat, is, that they are disseminated upon the farm, and thus tend to augment the natural growth of herbage.

7. *Rye-grass*, (*Lolium perenne*.) This is extensively cultivated in Scotland, and in the north of England, and forms the principal seed sown with clover. There are several varieties; some of which are annual, and others biennial and perennial. The Italian rye-grass has within a few years attracted notice, as being superior to the other kinds. The common kinds have been repeatedly tried in the United States, but generally with poor success—our summers being too dry, and our winters too cold for it. We have also twice tried the Italian variety, but the result has induced us to abandon it, as unsuited to our climate. To those who wish to try the rye-grass, it will be proper to add, on the authority of Dickson and others, that it is a good pasture grass, and is valuable in rich moist meadows; that cows and sheep eat it freely; and that Arthur Young considers the orchard-grass superior to it. The biennial rye-grass is preferred for a first crop with clover, as being of larger growth, and better suited to alternate husbandry. The perennial is preferred for grounds that are to be left longer in grass, as it abides several years. The Italian variety gives the largest produce, and, were it hardy enough to withstand the cold of our winters, would no doubt become a valuable acquisition to our husbandry.

The seed sells in the American shops at three to four dollars a bushel. On the whole, we do not recommend its culture, except in elevated or humid districts.

We have enumerated, we believe, all the grasses, that have hitherto been cultivated in the United States to any considerable extent. There are many other species, indigenous and foreign, which might be worthy of our notice, and which may yet form valuable accessions in our husbandry, whenever they shall be brought into notice, cultivated, and their merits determined, in experimental

farming. There are other grasses that spring up spontaneously, and which produce a good turf without labor, as the blue-grass of the western States, or flat-stalked meadow-grass, (*Poa compressa*,) the smooth-stalked meadow-grass, (*Poa pratensis*,) the red meadow-grass, (*Poa aquatica*,) and the rough-stalked meadow-grass; (*Poa trivialis*;) also many species of the *festuca* and *agrostis* genera, particularly the *A. stricta*, of which our quack or witch-grass is a variety.

Upon this last it may be well to remark, that Dr. Richardson first brought this grass into notice, as a superior forage, well adapted to reclaimed bogs and swamps, particularly in mountainous districts, in localities where other grasses will not thrive. The peculiar value of the fiorin arises from the concrete sap laid up in its numerous joints; and indeed it may be remarked that the straw or stems, of all plants, are rich in nutriment in proportion to the frequency of their joints, which are peculiarly the deposit of nutritious matters. The fiorin suffers less in weight and nutriment, by frosts, than any other grass; and of course affords good winter pasture. It is propagated by stolens or roots; the ground being previously drained, and ameliorated by one or more crops, for which purpose potatoes or other root crops are preferable. The surface is made smooth and clean, the strings or roots are then strewed over it, and a compost, consisting in part of bog-ashes, lime, and loam, spread over, sufficient to prevent the roots being blown away. The quack, switch, or witch grass, a variety of the fiorin, is highly nutritious, roots and all, and, if cultivated for forage, might prove a profitable crop; but the objection is, it interferes too much where it is not wanted, and will stay where it is once introduced. In pasture grounds, however, it seldom abides after the third year.

We will endeavor to class the grasses of which the seeds can be procured in this country, according to the best data in our possession, for the uses to which they are best adapted, and to indicate the soils on which they respectively thrive. But before we do this, we will introduce Dickson's classification of grasses for different

soils in Great Britain, which will show the quantity and variety of seeds sown to the acre in that country.

*Clayey Soils.* Marl or cow-grass, 5 lbs. ; trefoil, 5 lbs. ; crested dog's-tail grass, 10 lbs. ; meadow fescue-grass, one bushel ; meadow foxtail grass, one bushel. And when the three last cannot be procured, meadow soft-grass, two bushels ; meadow cat's-tail, or timothy, 4 lbs.

*Loamy Soils.* White clover, 5 lbs. ; crested dog's-tail, 10 lbs. ; rye-grass, one peck ; meadow fescue-grass, three pecks ; meadow fox-tail, three pecks ; yarrow, two pecks. Or, where the second cannot be had, rye-grass, one peck ; and rib-grass, 4 lbs. And in room of the last three, meadow soft-grass, half a bushel ; timothy grass, 4 lbs. ; marl or cow-grass, 5 lbs.

*Sandy Soils.* White clover, 7 lbs. ; trefoil, 5 lbs. ; burnet, 6 lbs. ; rye-grass, one peck ; yarrow, one bushel. Or, instead of the last, rib-grass, 4 lbs. ; rye-grass, 1 peck.

*Chalky Soils.* Burnet, 10 lbs. ; trefoil, 5 lbs. ; white clover, 5 lbs. ; yarrow, one bushel, or, in its place, rye-grass, one bushel.

*Peaty Soils.* White clover, 10 lbs. ; crested dog's-tail grass, 10 lbs. ; rye-grass, one peck ; meadow fox-tail grass, two pecks ; meadow fescue-grass, two pecks ; cat's-tail, or timothy grass, one peck. Or in place of the second, fourth, and fifth, meadow soft-grass, six pecks ; rib-grass, 5 lbs. ; marl or cow-grass, 4 lbs. Our classification embraces—

I. Grasses best suited to arable lands, and designed to alternate with grain and roots.

II. Those best adapted for hay or meadows ; and,

III. Grasses which are most profitably sown for perennial pastures.

I. There are several descriptions of land which are much more profitably employed in tillage than in grass, particularly those that are dry or light, and which have little tendency to produce good herbage. Yet constant cropping with grain would soon exhaust them of fertility, without an expense for manure which few can afford. The system of introducing artificial or sown grasses, after two, three, or four years' tillage, is happily calculated to

avert the evil, and constitutes one of the late improvements in farming. "The lands are thereby not only prevented from being so much exhausted as would otherwise be the case, and at the same time rendered fit for the growth of particular kinds of grain, without the necessity of fallowing; but a much larger proportion of green and other food, than could otherwise be obtained, is provided for the support of live stock." The grasses best adapted to this purpose, are the red and white clovers, lucerne, and the orchard, tall oat, timothy, and rye grasses. Clover is the primary dependance on all soils that will grow it, and particularly where gypsum can exercise its magic powers. As vegetables are said to exhaust the soil in proportion to the smallness of their leaves, (the larger and more succulent these, the more nutriment the plant draws from the atmosphere, and the less from the soil,) clovers are entitled to the high commendation they have received among American farmers. But as these plants are liable to premature destruction by the frosts of winter, it is prudent and wise to intermix with their seeds those of some other grass more to be depended on. For this purpose,

*On sands, light loams, and gravels*—and these constitute the soils usually employed in convertible husbandry—the orchard-grass, or tall meadow oat-grass, appears best calculated to insure profit. They grow early, delight in a clover soil, and are fit for the scythe when clover is in bloom—the period at which it ought to be made into hay. The hay from this mixture may be made before the harvest commences; and if the soil is good, a second crop may be cut almost equal to the first. If intended for pasture, the second or third year, either of these grasses will afford more abundant herbage than timothy. Lucerne may be sown on deep sandy loams.

*On clays and heavy loams*, timothy may be sown alone, or those grasses named in the preceding paragraph, separate or mixed.

*On wet soils and reclaimed swamps*, as the only object of tillage ought to be to prepare the ground to be laid down in grass, the kinds indicated in the preceding remarks as suitable for such soils, and intended for meadow

grasses, should be selected, yet so scanty is our assortment, that we can only name timothy and herds-grass.

II. MEADOWS. These may be classed under three heads : viz., low or alluvial lands, on the banks of rivers, creeks, and brooks ; uplands naturally moist, or of clay or heavy loam ; and reclaimed bogs and swamps. These soils, to adopt a common term, are *natural to grasses*, while the expense of tillage, and the uncertainty of a crop, render it most proper to appropriate them to grass. The objects, in stocking meadows, are, to select those grasses *which yield the greatest burden of hay, and afford the most nutriment for cattle*. When mixed seeds are employed, care should be taken to select those which can be most profitably cut at the same time. The impropriety of mixing timothy and orchard-grass, for instance, will be apparent, from observing that the last should be cut in the latter end of June, while the former continues to improve till the first of August. Timothy is undoubtedly the best grass which we can employ for meadows, on moist or tenacious soils. Herds-grass, and rough-stalked meadow-grass, often come in spontaneously. And if the timothy is left standing until its seeds have formed, seeds enough fall to supply new plants.

*For light loams, sands, and gravels*, the tall oat and orchard grasses are probably the best ; and to these may be added red and white clover.

The great difficulty is, to prevent the deterioration of meadows. This takes place from the better grasses running out, and giving place to coarser kinds, to mosses, and to useless and noxious plants ; aided, often, by a neglect to keep them well drained.

Hence it is of the first importance to keep the surface soil free from standing water, by good and sufficient drains ; and it often becomes necessary, and in most cases advisable, on a flat surface, to lay the land in narrow ridges, at right angles with the ditches. Another precaution to be observed is, not to depasture them with heavy cattle when the ground is wet and poachy. Harrowing in the fall has been found beneficial to meadows. It destroys mosses, covers the seeds of grasses which have fallen,

or have been previously sown, and thus produces a succession of young plants. In Europe, top-dressings of lime, marl, compost, ashes, and yard manure are repeated at intervals of two or three years. In Flanders, extensive applications are made in this way, of the urine of animals, after it has fermented, or been diluted. It is collected in cisterns under the stables, and adjoining the yard in which the stock are fed, summer and winter. With us, the annual application of a bushel of plaster of Paris is found beneficial, on most lands not absolutely wet. The gypsum not only thickens the verdure with clover, but is of advantage to most of the other grasses. Stable manure should be applied only when it can be spared from the more profitable uses of tillage, as it is far more beneficial mixed with the soil than spread upon the surface. Its most economical application as a top-dressing, is in the form of compost, made by mixing it with bog-earth, river mud, the wash from the highways, or other rich earth, at the rate of one load of dung to five or six of earth. If turned and mixed well, this constitutes a valuable top-dressing for grass grounds, and is best applied in the autumn. When these means fail to insure a good crop of hay, it is time to resort to the plough, a course of crops, and reseedling.

III. PASTURES. Here the object is to obtain those grasses which are most nutritious, relished by cattle, and which supply green feed from March to December, or such a mixture as will give a succession of fresh herbage during the grazing season. The tall-oat, rye, and orchard grasses are best adapted to the lighter and drier soils, where the spontaneous growth of clover and other indigenous grasses should be encouraged by top-dressings, or the application of plaster. In moist and stiff grounds, timothy and herds-grass may be sown with the tall-oat. Our observations, under the preceding head, in regard to draining, top-dressing, sowing seeds, and scarifying or harrowing, lose none of their force when applied to pasture grounds. It is believed, that, if once introduced upon our farms, the valuable grasses which we want would propagate themselves. If so, how important is it that we obtain them, particularly those which our seed-shops already afford.



Table of the comparative product and value of grasses, as experimented upon at Woburn, under the direction of the Duke of Bedford.

BOTANIC AND ENGLISH NAMES.	Natural duration.	Height in wild state in inches.	Soil employed.	When weighed.	Grass on 4 sq. feet.	Weight per acre when green.	Weight per acre when dried.	Loss in drying.	64 dtms gave of nutritive matter.	Nutritive matter in one acre.	When in flower.	When in seed.	Proportionate value which the grass bears at the time of flowering to that which it bears in time of seedling.	When best cut for hay.	General character.
<i>Anthoxanthum odoratum</i> * — Sweet-scented vernal grass,.....	Per.	12	Sandy loam.	In flower, In seed, L. Math.	9 9 10	7847 6125 6306	2103 1837 239	5723 4237 .....	1 0 1	122 311 239	April 29.	June 21.	4 to 13	In seed.	Early pasture grass.
<i>Holcus odoratus</i> , Hrst. — Sweet-scented soil grass,.....	Per.	14	Rich sand loam.	In flower, In seed, L. Math.	14 14 25	9578 9725 17015	2441 9878 .....	7087 17696 .....	4 1 1	610 2233 1129	April 29.	June 25.	17 to 21	In seed.	The most nutritive, early grass.
<i>Alopecurus pratensis</i> — Meadow fox-tail,	Per.	24	Clay loam.	In flower, In seed, L. Math.	30 19 12	20418 12531 88167	6125 5919 .....	14393 7111 .....	1 2 2	270 461 255	May 30.	June 24.	9 to 6	In flower.	One of the best meadow grasses.
<i>Poa pratensis</i> * — Smooth-stalked meadow grass,.....	Per.	18	Bag earth & clay.	In flower, In seed, L. M. th.	15 12 6	10209 8807 4083	2871 3403 .....	7237 5104 .....	1 3 1	279 199 111	May 30.	July 14.	.....	In flower.	Good early hay grass.
<i>Avena pubescens</i> * — Downy oat grass,...	Per.	18	Rich sand loam.	In flower, In seed, L. M. th.	23 10 10	15654 6906 6306	5570 1361 .....	9768 5445 .....	1 2 2	366 212 212	June 15.	July 8.	6 to 8	In seed.	Good pasture grass.
<i>Poa trivialis</i> * — Roughish meadow grass,	Per.	20	Mannared light loam.	In flower, In seed, L. Math.	11 11 7	7437 7327 4764	2546 3322 .....	5340 4304 .....	2 0 3	253 335 223	June 15.	July 10.	8 to 11	In seed.	Good on rich moist soils.
<i>Agrostis stricta</i> — Upright bent grass,...	Per.	9	Bag soil.	In flower, In seed.	11	7456 4764	2713 1310	4772 3451	1 2 2	446 260 47.	July 28.	Aug. 30.	8 to 5	In flower.	
<i>Festuca rubra</i> * — Purple fescue grass,...	Per.	12	Light sand.	In flower, In seed, L. Math.	15 15 5	10409 10890 30403	3557 4900 .....	6651 5989 .....	1 2 2	239 340 79	June 20.	July 10.	6 to 8	In seed.	Good long gr.
<i>Festuca ovina</i> — Sheep's fescue grass,...	Per.	6	Light sand.	In flower, In seed, L. Math.	8 8 5	5445 3403	.....	.....	.....	127 66	June 24.	July 10.	.....	.....	Good long gr.

<i>Dactylis glomerata</i> * — Rough head cock's-foot grass,.....	Per.	24	rich sand soil.	in flower. in seed. L. Math.	41 39 17	27,305 26544 1910	11859 13272 13272	16015 13272 13272	2 2 3 2 2 2	1089 1451 281	June 24.	July 14.	5 to 7	In seed.	A most pro- ductive grass, but coarse.
<i>Poa angustifolia</i> — Narrow-leaved mead- ow grass,.....	Per.	24	Brown loam.	in flower. in seed. L. Math.	24 17	18576 9528	7810 3811	10566 5717	5 0 5 1	1130 701	June 28.	July 16.	3 to 2	In flower.	Excellent hay grass.
<i>Trifolium pratense</i> — Red clover,.....	Ben.	.....	T. clay.	in seed.	72	49005	12,251	3675	2 2	1914	July 18.	Aug. 6.	.....	In flower.	.....
<i>Medicago sativa</i> — Lucerne, Fr. clover, <i>Hedysarum onobrychis</i> — Sainfoin,.....	Per.	36	Cl. l'm.	in seed.	104	70785	28314	4271	1 2	7659	July 18.	Aug. 6.	.....	In flower.	Best for soil'g
<i>Festuca duriuscula</i> * — Hard fescue grass, <i>Festuca pratensis</i> — Meadow fescue grass,	Per.	12	Sandy loam.	in flower. in seed. L. Math.	27 28	18576 19075	9399 8575	10116 10481	3 2 1 2	1004 199	July 1.	July 20.	14 to 6	In flower.	Good for hay or pasture.
<i>Lolium perenne</i> — Perennial rye grass, <i>Festuca lolacea</i> — Spiked fescue grass,	Per.	36	Rich loam.	in flower. in seed. L. Math.	24 16	16335 10890	7146 4482	9188 6397	3 0 3 1	7655 553	July 1.	July 20.	10 to 11	In seed.	Generally es- teemed.
<i>Avena elatior</i> — Tall oat grass,.....	Per.	50	Brown loam.	in flower. in seed. L. Math.	24 22	16335 4492	3717 4482	10617 19481	1 0 2 2	265 305	July 6.	July 28.	.....	In seed.	Most valuable for hay and pasture.
<i>Festuca elatior</i> * — Tall fescue grass,....	Per.	36	Black rich loam.	in flower. in seed. L. Math.	75 75	51046 51046	17866 17866	33180 33180	5 0 3 0	3938 2392	June 28.	July 16.	20 to 12	In flower.	Ex. mead. gr.
<i>Festuca fluitans</i> * — Floating fescue grass, <i>Holcus lanatus</i> * — Meadow soft grass,...	Per.	18	St. clay.	in flower.	26	13612	4083	9528	1 3	372	July 14.	Aug. 12.	.....	.....	Aquatic grass.
<i>Poa fertilis</i> , Host. — Fertile meadow gr. <i>Phleum pratense</i> — Meadow cat's tail gr.	Per.	24	St. clay loam.	in flower. in seed. L. Math.	28 28	19057 19057	6661 3811	19305 19246	4 0 2 3	1191 898	July 14.	July 26.	12 to 11	In flower.	Early and productive.
<i>Avena flavescens</i> — Yellow oat grass,....	Per.	18	Cl. l'm.	in flower.	60	40837	17355	22481	2 2	1595	July 11.	July 28.	.....	.....	An early gr.
<i>Agrostis vulgaris</i> — Fine bent grass,....	Per.	18	Clay loam.	in flower. in seed. L. Math.	60 60	40837 40837	19397 19397	21439	5 3 2 0	3689 237	July 16.	July 30.	10 to 23	In seed.	Ex. for hay.
<i>Agrostis vulgaris</i> — Fine bent grass,....	Per.	18	S. soil.	in seed.	14	9528	4764	4764	1 2	251	July 24.	Aug. 20.	.....	.....	Valuable gr. An early gr.

Those marked with an \* are natives of the United States.

## CHAPTER XXIII.

## THE ATMOSPHERE, AND ITS USES TO THE HUSBANDMAN.

A KNOWLEDGE of the constituents of the atmosphere, and of the various and important offices which it performs in animal and vegetable economy, is valuable to the farmer, not only as aiding him in promoting the health of himself and his family, and of his brute animals—and in all his rural and money-making operations—but as offering a source of high intellectual enjoyment. Although the subject may be deemed too abstruse for the generality of farmers, we consider it fraught with so much useful instruction, that we venture to say it will be read with interest by many of our young friends, and we would fain hope that it may lead some of them into a course of study, in physical science, which will not only benefit them individually, but ultimately become beneficial to the human family. Neither fame nor fortune is hereditary. And let no young man be deterred from aspiring to both, because he is the son of an humble farmer. The brightest geniuses of the age have come from the plough. The Creator has endowed us with power to become acquainted with many of the apparent phenomena of Nature, and of rendering them subservient to our wants; and, in this free country, the humblest individual has ample leisure and means to pursue the investigation, and win the reward. The time and means that are usually devoted, in early life, to frivolous, and often deleterious pleasures, would suffice to lay in a stock of useful knowledge, which would become a treasure and a blessing in after-life. But it should never be forgotten, that in all our undertakings, mental, moral, and physical, a determined perseverance is the only rational prelude to success. With these views and hopes, we shall briefly describe the principal constituent parts of the atmosphere, and some of its more important offices, that seem most likely to interest the agriculturist.

The atmosphere is composed principally of two invisible gases, termed *oxygen*, (sometimes vital air, being indispensable to animal life,) and *azote* or *nitrogen*, in the proportion of about four fifths of the latter to one fifth of the former. This proportion is found to exist, with trifling modifications, in all latitudes and at all elevations. Although these elements are invisible in the atmosphere, they both assume liquid and solid forms under many and various circumstances.

Nitrogen abounds in animals, but seldom to a great extent in plants. It is however found in wheat, in what is denominated gluten, and it is this which gives to that grain its prominent value. It abounds in the urine, but seldom, or but partially, in the dung of animals. "It is the base of ammonia and nitric acid, (aqua fortis,) and appears to be the substance which Nature employs in converting vegetable into animal substances."—*Fourcroy*. Its principal office seems to be, to neutralize, in some measure, the properties of oxygen, and to render it fit for respiration and combustion.

Oxygen enters more or less into all animal and vegetable matters. It constitutes 88 parts in 100 of water,—forms from 40 to 70 per cent. of all vegetable acids,—more than 40 per cent. of the wood of the oak and beech,—about 50 per cent. of starch, the nutritious property, next in value to gluten, of grain, pulse, and roots, and 64 per cent. in sugar. It is essential to animal and vegetable life; it is necessary to fermentation, to combustion, to the germination of seeds, and to the growth and maturity of plants; and combining with the carbon of the blood, it produces the greatest proportion of animal heat. It also combines with metals and forms oxydes, or, in common language, *rust*.

Nitrogen and oxygen are called simple bodies, because they are supposed to be incapable of division or decomposition.

*Carbonic acid gas*, also, is found to constitute about one thousandth part of the atmosphere; and in winter, it has been found to amount to one five hundredth part. This is a compound substance, composed of two parts of oxy-

gen and one of carbon, the latter being found pure in the diamond, and forming the substance of mineral and wood coals. This gas is produced in abundance by fermentation, respiration, and combustion, is absorbed and decomposed by the leaves of plants, the oxygen being set free, and the carbon being converted into wood, &c. The causes which produce it, sometimes, in confined situations, give it in such excess as to render it prejudicial to animal health; but the free access of atmospheric air soon restores the equilibrium. It constitutes much of the proper food of plants. Thus animals and vegetables are mutually benefited, through the wise provision of the Creator, by their proximity to each other—plants giving off oxygen, necessary to animals—and animals giving off carbonic acid gas, the pabulum of vegetable life.

*Water* also exists in the atmosphere, in the form of an elastic fluid. This fluid is found to form, at the temperature of 50° Fahrenheit, about one fiftieth of the volume of the atmosphere, in the driest time in summer, and is increased with the increase of temperature—heat accelerating the evaporation of moisture from the earth's surface. When the temperature of the air is diminished, the aqueous fluid is condensed, and appears in the atmosphere in the form of vapor, or clouds, and is copiously deposited, in summer, in the form of dew. This water is retained, principally, in the lower regions of the atmosphere. It is so slightly united with the other elements of the atmosphere, that a change of temperature produces a change in its proportions; whilst nitrogen, oxygen, and carbonic acid preserve, always, nearly the same relative proportions.

“Independently of those bodies which essentially constitute the atmosphere,” says Chaptal, “there are mingled in it the exhalations constantly arising from the earth; these are again disengaged from the air, and precipitated, as soon as the heat, or any other cause which occasioned their ascension, ceases to act upon them. These exhalations modify the properties of the air, [by the carbonic acid gas, &c. disengaged from animal and vegetable matters in a state of putrefaction,] and affect its purity. The oxygen and the water of the atmosphere become impreg-

nated with the particles of the exhalations, which are deposited with them upon the surfaces of other bodies, when they remain in contact, or enter into combination, with them. The origin and dissemination of many maladies may be traced to this source; the germ of them is carried through the air by the aqueous fluid. And for the same reason it is, that intermittent fevers are endemic in those situations where large quantities of vegetable matter are undergoing decomposition, as upon the borders of ponds and marshes; and that the miasm, which arises from numerous animal remains, in a state of decomposition, becomes a fruitful source of disease. It is for the same reason also dangerous, under some circumstances, to breathe the evening air; the aqueous fluid contained in it is loaded with noxious principles, which the heat of the sun, during the day, had caused to ascend into the atmosphere. The disagreeable odor, conveyed to us in mists, is owing to the power of the aqueous fluid in transmitting the exhalations arising from the earth. The manner in which the air conveys to us the perfume of plants, and the odors which it contracts from the exhalations of bodies in a state of decomposition, indicates clearly its influence in producing maladies, and still more plainly its power of propagating those that are contagious.”—*Chemistry applied to Agriculture*.

According to the best authorities, a man inhales, or takes into his lungs, from six to ten pints of air at every respiration or breath. This air comes in contact with the blood in the lungs, and both the blood and the air undergo a material change in consequence. The blood imbibes a portion of the oxygen from the air, assumes a florid red hue, and acquires thereby the power of supporting life, and is fitted to become a part of the living animal. The air receives, in return for the oxygen, or vital air, which it gives to the blood, about an equal portion of carbonic acid, which vitiates it, and renders it unfit for further respiration; or, if this vitiated or impure air is again respired, the blood becomes likewise vitiated by its contact with it, and all its functions become more or less disordered. Atmospheric air, as we have observed, con-

tains about 79 parts of nitrogen, 21 of oxygen, and nearly one of carbonic acid. A greater or less quantity of oxygen unfits it for healthy respiration, and causes disorganization and disease in the animal system. When atmospheric air is inhaled upon the lungs, it parts with 8 or  $8\frac{1}{2}$  per cent. of its oxygen, and receives in return a like quantity of carbonic acid. Thus atmospheric air becomes rapidly vitiated by being breathed, and is as speedily restored to its purity by healthy vegetation, which takes up the carbonic acid, or decomposes it, and gives off, or sets free, oxygen. According to Dr. Bostock's estimate, an average-sized man consumes about 45,000 cubic inches of oxygen, and gives out about 40,000 of carbonic acid, in 24 hours. "Taking," says Dr. Combe, "the consumption of air at 20 cubic inches at each breathing, as a very low medium, and rating the number of respirations at 15 in a minute, it appears that, in the space of one minute, no less than 300 cubic inches of air are required for the respiration of a single person. In the same space of time, 24 cubic inches of oxygen disappear, and are replaced by an equal amount of carbonic acid, so that in the course of an hour one pair of lungs will, at a low estimate, vitiate the air by the abstraction of no less than 1,440 cubic inches of oxygen, and the addition of an equal number of carbonic acid, thus constituting a source of impurity which cannot with safety be overlooked."

Atmospheric air becomes vitiated by one, or a combination, of the following causes :—

1. By animal respiration ;
2. By decaying animal and vegetable matters ;
3. By stagnant waters ; and,
4. By combustion in close apartments.

Many cases are cited of the fatal effects of breathing highly-vitiated air in prisons, in small, close apartments, and in unhealthy districts. One of the most horrible was that which occurred in the Black Hole of Calcutta, where one hundred and forty Englishmen were thrust into a confined place, eighteen feet square, in which there were but two small windows on one side, and where ventilation

was impossible. Scarcely was the door shut upon the prisoners, when their sufferings, for want of fresh air, commenced, and in six hours ninety-six of them were dead. In the morning only twenty-three of them were living, many of whom were subsequently cut off by putrid fever, caused by the dreadful effluvia and the corruption of the air. Other cases are recorded of persons dying, for want of fresh air, in small, close cabins; and numerous cases are annually recorded of deaths caused by burning charcoal in close apartments, where the oxygen is abstracted from the atmosphere, by the carbon of the charcoal, to form carbonic acid. But it is not only where death or severe sickness ensues, that the breathing of vitiated air is hurtful; it is *always* prejudicial, more or less, to health; it impairs the constitution, and is often the latent cause of diseases which ultimately prove fatal. "The chief symptoms," says Orfila, "which follow the breathing impure air, are great heaviness in the head, tingling in the ears, troubled sight, a great inclination to sleep, diminution of strength, and falling down." These sensations are experienced in crowded, heated rooms, in steam-boat and canal-boat cabins, &c.

Decaying animal and vegetable matters are a prolific source of disease, by vitiating the atmosphere we breathe, particularly in cellars, close yards, or other places where the effluvia they generate are not speedily dissipated by the winds. Hence fevers are most prevalent where due regard is not had to cleanliness, as in dwellings where there are wet and dirty cellars, adjoining filthy yards and lanes, and in houses in and about which animal and vegetable matters are suffered to accumulate and putrefy. Hence the sickness that pervades newly-cleared countries, from the decay of vegetable matters, on the first exposure of the soil to the full influence of solar heat.

The deleterious influence of stagnant waters upon the atmosphere is known to all, and when combined with animal and vegetable putrefaction, the evil is greatly increased. Hence the draining of marshes and wet lands contributes essentially to the healthiness of a neighborhood.

Combustion also vitiates the air in close rooms, par-



ticularly gas-lights—a single gas-burner consuming more oxygen, according to Combe, and producing more carbonic acid gas, to deteriorate the atmosphere of a room, than six or eight candles.

We shall not speak of the other matters which commingle in the atmosphere, as light, heat, and electricity, although they possess a great influence upon animals and plants—but proceed to the improvement, and the application to rural affairs, of the facts already established.

We MAY profit by THESE truths :—

1. *In selecting sites for our dwellings*—taking care to have them in airy situations, remote from marshes, ponds, and stagnant waters, which vitiate, by the exhalations they give, the atmosphere we breathe, and thereby generate disease.

2. *In the manner of constructing our dwellings.* The cellars should be dry, with windows at opposite sides, for ventilation, whenever the weather will permit. The rooms should be lofty, and rather capacious than contracted, should all open, by windows, to the exterior, and should be ventilated every fair morning in summer.

3. *In improving our personal and domestic habits,* by practising cleanliness, an ancient, if not a modern virtue ;—by avoiding the deleterious influence of the night air, especially in autumn, when much vegetable matter is in the process of decay ;—by well ventilating our apartments, particularly when the atmosphere is pure and salubrious ;—by keeping our cellars free from putrefying vegetables, and other filth ;—by graduating the temperature of our rooms in winter, which should not be suffered to rise above 64° of Fahrenheit ; by avoiding hot sleeping-apartments, in which the temperature often varies, between the hour of going to bed, where fires are kept up, and the hour of rising, when the fires have gone out,—a transition too trying for the most robust constitution ;—by abandoning the use of foot-stoves, which transform our wives and daughters into green-house plants, and render them too sensitive to cold, poison the air they respire, and beguile them into indolent and inactive habits, as detrimental to their health as to their useful-

ness ;—by taking frequent exercise in the open air, when our habits are studious or sedentary ;—by sleeping in rooms without fires, with open partition doors, that fresh air may at all times have free access, and by avoiding lodging too many persons in the same room ;—and by inducing our females to go warmly and tidily clad, as well to church as to parties of pleasure. How many human constitutions are ruined, in our cities and villages, by indulging in habits which philosophy and reason teach us to avoid.

4. *In multiplying ornamental trees and shrubs about our dwellings*, which serve to purify the air, abate the fervor of summer heats, by carrying off a portion of the caloric with the moisture they exhale, and which are withal an embellishment and an evidence of good taste.

5. *In the construction of our stables and cattle-sheds*. Farm-stock are as much benefited by cleanliness and good air as man ; and the same precautions which go to secure the health of the latter are essentially requisite to promote the thrift and well-being of the former. Hence the importance of having clean and well-ventilated stables and sheds, of removing the dung so that it does not undergo fermentation in the stalls, and of giving cattle wholesome exercise.

6. *In the planting of our seeds*. The atmosphere being essential to germination, both on account of the oxygen and heat which it contains, all seeds should be deposited in the soil within its reach ; they should be put just so low as will barely secure about them moisture enough to insure their germination. We have reason to think, that small seeds often fail to grow from being buried too deep in the soil, and that, even if they germinate, the food which the cotyledons afford, and which is their only support till the seminal leaves are developed, is not sufficient to carry the plumula, or upright shoot, to the earth's surface, where alone the leaves can exercise their office of elaborating or preparing the food.

7. *In the management of our field and garden crops*. The soil has a strong affinity for water, and the atmosphere penetrates it freely, when pulverulent and loose ; but

where the soil is compact and crusted, neither the atmosphere nor the dews are able fully to exert their salutary influence in promoting the growth of the vegetation upon it. In the former case, the soil is like a sponge, pervious to atmosphere and dew, and transmitting both to the roots of plants, with the elementary food with which they are both charged. But where the earth is hard and crusted, by alternate rain and sunshine, neither dew nor air penetrates freely, and the former is dissipated by the first rays of the morning sun. Hence the best preventive against the evils of drought, is the frequent stirring of the surface, and keeping it constantly permeable to atmospheric air, and the vegetable nutrition with which it abounds. We remember an account of a remarkable illustration of the benefit of frequently stirring the surface of cultivated lands, given by Curwen, a distinguished British agriculturist. He prepared a field of stiff, forbidding land, and planted it with cabbages. His neighbors all declared he would get no crop; but he put a horse and cultivator among the plants, and subjected the ground to almost constant stirring during the growing season. The result was, he gathered an immense crop, some of the cabbages weighing over 50 lbs. each. The farmer may derive great benefit from this practice in the culture of drilled and hoed crops, provided he does not go so deep as to cut the roots of his plants, or throw his manure to the surface.

8. *In draining our wet lands*, which will contribute at the same time to promote health, and augment our profits. For, generally speaking, our wet and marshy lands are the richest in organic matters, and become the most profitable to the owner, when thoroughly drained. And, lastly, we may profit from the facts we have detailed—

9. *In the management of our manure*. All the food of vegetables must be resolved into a liquid or gaseous form, before it can enter the mouths of plants, or become incorporated in the vegetable structure. This change is effected, in dung, by fermentation or decomposition, by which the parts are separated. The gaseous matters first escape. If fermentation takes place in the soil, the earths

imbibe, and the plants growing thereon are nourished by them. If fermentation takes place upon the surface, either in the yard or in the field, these gases rise, from their specific gravity being less than that of atmospheric air, and are dissipated by the winds. The liquid matters escape next. If buried in the soil, the soil absorbs and gives them off to plants. If left upon the surface, they are washed away by rains, or sink, with little or no benefit to the owner, into the earth beneath them. The whole of the matter of dead animals and plants is convertible, if buried in the soil, into living plants, by the ordinary processes of Nature ; and it is capable, however solid it may seem, of being reduced to liquid or gaseous forms, fitted to the wants of our crops. Indeed, it proceeds to take these forms immediately, on its losing its vitality, as soon as it comes in contact with air, heat, and water, the great agents of decomposition. The moment fermentation begins, the waste of vegetable food begins, if the fermentation takes place upon the surface ; carbonic acid gas is disengaged, and is scattered by the winds ; the oxygen of the atmosphere, uniting with the hydrogen of the mass, forms water, which settles into the ground, or is carried off by the rains ; the mass is reduced in volume ; and when fermentation has exhausted its force, it has lost one half of its fertilizing properties. If the fermentation takes place in the dung-yard, or upon the field, we repeat, this half is lost to all useful purposes of the farm. If it takes place in the soil, the earth imbibes it, and the plants growing thereon are fed and nourished by it—the gases and liquids are converted into the solid matter of the growing crop, be it grain, grass, pulse, or roots.

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## CHAPTER XXIV.

### ON THE GERMINATION OF SEEDS.

SEEDS often fail to grow ; and the seedsman is as often blamed, for vending bad seeds, when they are really

good, and when the cause of their not growing is owing to the gardener or planter. To induce germination, moisture, atmospheric air, and a certain temperature, are indispensable; and it is also requisite that light be excluded, until the nutriment in the seed is exhausted, or until the root can draw nourishment from the soil. The first effect of the air, heat, and moisture upon the seed is to change its properties,—to convert its starch into sugar—into a sort of milky pulp, the proper food of the embryo plant. If at this stage the seed becomes dry, its vitality is believed to be destroyed; but if these agents are permitted to exert their influence, the contents of the seed swell by degrees, and the first point of the future root, having formed, breaks through the shell in a downward direction, and at about the same time the point of the future stem comes forth in an upward direction. The presence of air, heat, and moisture is as indispensable to the growth of the plant, as it is to the germination of the seed.

Now it often happens, when seeds are planted in fresh-stirred ground, or where the soil is moist, they undergo the incipient process of fermentation, and the earth not being pressed upon them, and dry weather ensuing, the moisture is abstracted, and the seeds perish. Too much moisture is also often destructive to the vital principle of seeds,—and others again are buried too deep to be vivified by solar and atmospheric influence. The first object in planting, therefore, should be, to place the seed just so far under the surface, and so to cover it with earth, as shall barely secure to it a constant supply of moisture. There are many seeds, as of the carrot, parsnip, orchard-grass, &c., which, if not previously steeped, or the soil well pulverized and pressed upon them, fail to grow for want of moisture. Hence, in sowing orchard-grass, it is found prudent to spread the seed upon a floor, and sprinkle it with water, before it is sown, and to pass a roller over the ground after it is sown. And hence, in light garden mould, it is advisable to press, with the hoe or spade, the earth upon all light seeds after they are sown.

But we would draw the attention of the farmer, as well as of the gardener, to another mode of preventing failure and disappointment in the growth of certain seeds—and that is, by *sprouting* them before they are planted. This may be conveniently done with Indian corn, pumpkins, mangel wurtzel, beets, &c., on the farm, and with melons, beans, cucumbers, peppers, and a great number of other seeds, which are assigned to the garden. The mode of doing it with the field-seeds we have named is this : Steep the seeds twelve or twenty hours in water of a tepid or warm temperature—then take off the water, and leave them in a warm place, covered, to exclude the light and prevent their drying, or in a dark cellar or room, and the radicles or roots will shoot in a few days, and may then be planted without injury. Being obliged to suspend our planting four days, on account of rain, we found our seed, which had been previously steeped, and set by in a dark room, with radicles two or three inches long. It was planted with but little inconvenience, and did remarkably well. Mr. I. Nott sprouted a part of his corn last year, while a part of the seed was not sprouted,—and, what is worthy the particular notice of the farmer, he assures us, that *the sprouted corn was not injured by the wire-worm, while the unsteeped seed was seriously injured*, although planted by the side of each other. Mr. Nott accounts for the difference in this way : The wire-worm attacks the chit, and feeds upon and destroys the germ ; but the radicles having protruded, and not being to the taste of the worm, the insect attacked the solid part of the kernel, where its progress was too slow, and too remote from the germ, to retard its growth. Mr. Nott also sprouted his mangel wurtzel seed, and planted it so late as the 27th of June. Almost every seed grew, and the crop might be called a good one early in September.

To sprout garden-seeds, procure two sods, of equal size, say 18 inches square ; lay one down in the corner of the kitchen chimney, grass down ; lay your seeds upon it ; if small, wrap them in a piece of brown paper ; then place the other sod upon them, grass up—water well with

warm water, and the seeds will sprout in twenty-four to forty-eight hours.

There is one manifest advantage in sprouting seeds,—it tests their goodness, and shows whether they will or will not grow. A small quantity of seed-corn, submitted to this test before planting, would in many instances prevent great loss to the farmer.

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## CHAPTER XXV.

### ON STALL-FEEDING CATTLE.

IN the management of our cattle, as in the management of our crops, much is lost for want of system and regularity. The stall-feeding of neat cattle for the butcher is annually increasing, and promises to increase in interest, as we progress in the culture of roots. There is probably the difference of one third to one half, in the profits of the business, whether it is well or badly managed. Under this view of its importance, we extract from the 'Farmer's Series' the following compendium of the management recommended in that work.

“The first point is the comfort of accommodation ; for in whatever way they [cattle] may be placed—whether under sheds or in close ox-houses—they should have the security of perfect shelter from the weather, with a certain degree of warmth ; that is to say—if in open hammels, the sheds should be broad, the roof low, and the floor well covered with an abundance of dry litter. We are, however, decidedly of opinion, that close walls will further the object more promptly ; though we do not coincide in the idea that it will be promoted by too much heat ; and we should therefore recommend a moderate degree of healthful ventilation. In these stalls litter is very frequently dispensed with—or else sand, or any rubbish, is substituted for straw ; but there can be no doubt that animals enjoy the comfort of a dry bed as well as their master, and the more they seek repose in it the better.

“ The next is strict regularity in the administration of food—both as regards the stated quantity and the time of supplying it. The periods may be regulated as the feeder thinks proper ; but, whenever adopted, should never afterwards be altered. Oxen are quiet animals, and those which are fed in the house soon acquire a precise knowledge of the exact hour at which food is usually given ; and if that be transgressed, or the quantity be not furnished, they become restless ; but if the time and quantity be strictly adhered to, they remain tranquil until the next period arrives. If no disturbance takes place, they, indeed, generally lie down to ruminate, and nothing will be found to forward the process of fattening more than this perfect quietude ; wherefore, the stalls should not only be well bedded, but light should be very much excluded, the doors should be closed, all outward annoyances as far as possible prevented—and, in short, every means should be used to promote complete ease, rest, and contentment.

“ Some persons serve out food as often as five times a day ; but the most prudent, and the better practice, is to give it as soon as possible after day-light, at noon, and some time before sunset ; which enables the animals to fill their bellies, and to have sufficient time for that quiet digestion which is interrupted by too frequent feeding. In stating that the quantity should be moderate, we however alluded merely to the not allowing the animal to have so much as to cloy him ; he ought always to have as much as he can fairly eat with a relish, but the moment he begins to toss it about, it will be then evident that the keenness of his appetite is satisfied, and it should be instantly removed.

“ The last is thorough cleanliness. The ox-house should be opened before day-light, and well cleansed, both by pail and broom, from every impurity. After the animals have been satisfied with food, whatever may remain should be instantly removed, and the cribs and mangers should be swept out, and washed, if necessary ; water should then be given without limitation.\* If their hides

\* According to an experiment stated by Sir John Sinclair, an old man was appointed to discover how often some cattle, consuming



be then wisped, it visibly occasions a very pleasurable sensation ; as they begin to fatten, the ancient coat falls off, and if this be accelerated by the curry-comb, the better appearance of the beast will well repay the trouble.”

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## CHAPTER XXVI.

### THE ECONOMY OF CUTTING UP CORN.

THIRTY years ago, we read a communication of John Nicholas, then we believe of Virginia, on the advantages of *cutting up* instead of *topping* Indian corn. These advantages appeared to us so palpable, that in the novitiate of our farming operations, twenty-odd years ago, we reduced it to practice ; and although since we have occasionally adopted the topping system, by way of comparison, we have made it our general practice to *cut up* the crop ever since. We are convinced, from our long experience, that it possesses over the old mode the following advantages.

1. *It saves labor.* With proper implements, which every farm can furnish without expense, two smart men will cut up and stook two acres in a day. They cannot top more than one acre, and they are to be bound, stoked, and backed off the field, or left to be bleached till the corn is harvested, when they have lost half their value. A hill is gathered with a blow in cutting up ; in topping, a cut must be made upon every stalk.

2. *It adds to the grain crop.* We have satisfied ourselves, by careful experiments, that we gain six to ten bushels of corn per acre, by cutting up, above what we

chaff and straw upon a farm, went to the watering-trough in a short winter's day, and, that he might not be confused in the execution of his orders, one particular bullock was pointed out for his report ; according to which, *it drank eight times in the course of the day*, and the man was convinced that the rest of the cattle drank as often as the one fixed on. Now, twice a day is generally the most in which they get water ; and they are not able, at one or two opportunities, to drink a sufficient quantity.—*Husbandry of Scotland*, p. 100.

obtain by topping our corn. And we account for it on the well-known principles in vegetable physiology, that all the nutriment of plants must be elaborated, or prepared, in the leaves, and that this elaborated sap, or prepared food, *descends*—consequently, that when the leaves *above* the corn are taken off, by topping, the grain can gain no further nutriment, or accession of growth; and that when the crop is cut up, and stooked, the grain does continue to obtain nutriment, and accession of growth, for some days, from the descending, or elaborated sap, with which the succulent stems are abundantly charged. The leaves also continue their elaborating process for some days after the corn is cut.

3. *It augments the cattle-fodder, and preserves its nutritious properties.* Cut and well stooked, neither the grain nor the forage is likely to be seriously injured by the weather, even if left in the field late. If topped, the tops must be exposed to the deteriorating influence of the rains, winds, and sun, until they are dry enough to bind, which diminishes their value. If cut up, the whole of the stalks are converted into forage. If topped, but a small part becomes useful. And if the butts are fed in the cattle-yards, they imbibe additional fertilizing properties from the urine and liquids which abound there, and which are lost if there is no litter to absorb them. Hence,

*In the fourth place,* it gives more food to the crops as well as to the cattle, by saving that which otherwise is often lost to the farm. And,

*Finally,* cutting up has this important advantage, at least in the north,—it secures the crop, both grain and forage, from the damage of early autumnal frosts—for after the grain is cut and stooked, it is not liable to injury from their occurrence. We may add, that the ground may be cleared two or three weeks earlier, for a winter crop, where it is desirable to sow in autumn.

## CHAPTER XXVII.

## ON RURAL EMBELLISHMENT.

THERE are few things better calculated to attach us to our HOMES,—where the social virtues love to congregate, and to dispense their blessings, than rural embellishments. This is true whether we apply the term to our neighborhood or individual abode. The public grounds about the great cities of the old continent, some of which comprise an area of five hundred acres, are the theme of general admiration, the theatres of healthful exercise and recreation, and the sources of high intellectual enjoyment. The lesser towns and villages, even of our own country, owe more of their charm and interest to the trees and plants which embellish their squares, streets, and grounds, in the eye of a man of taste, than to any ostentatious show of brick and mortar—more to the beauties of Nature, than to the works of man. Nay, the highest efforts of the human intellect are in vain put in requisition to imitate the handiworks of the Creator. And when we come down to the suburban residence, and even to the unostentatious abode of the farmer, how are their beauties heightened, and their value enhanced, by a screen of ornamental trees, and a well-kept garden.

Loudon tells us, that in travelling from Strasburgh to Munich, he passed through a continued avenue of forest and fruit trees, planted on both sides of the highway, for more than one hundred miles. Who that has passed through New England, in summer, has not admired the beautiful trees with which he is in a measure enshrouded? The great objection to planting is, that one may not live to enjoy the fruit or the shade of the trees which he plants. Such an objection is unworthy of the age, which should, if it does not, have regard to the interests of the human family, and of posterity,—and is, besides, affecting to hold a shorter tenure of life than all of us hope

for, and most of us expect. Twenty years ago, at forty years of age, we commenced the cultivation of what was termed a barren, untameable common, not an acre of which had been cultivated, and on which a tree or shrub had never been planted by the hand of man. We have now growing in our court-yard, comprising about half an acre, and in the highway in front of it, fifty species of forest and ornamental trees, many of them forty and fifty feet high, more than fifty species of ornamental shrubs, not including the rose, besides a vast number of herbaceous, ornamental, and bulbous and flowering perennial plants—the greatest number of which, in all their variety and hue of foliage, flowers, and fruit, may be embraced in a single view from the piazza. Most of our fruits have been raised by us from the seed, or propagated by grafting or budding. Yet we can enumerate more than two hundred kinds, including varieties, which we are now in the habit of gathering annually from trees, vines, &c. of our own planting. We feel grateful to God for these rich and abundant blessings, and for the impulse which prompted our labor. We have adduced our own example, not in a spirit of vaunting, but to convince the young and the middle-aged, that there is abundant reason for them to plant, with the hope of enjoying the fruits of their labor. The old *should* plant from an obligation they owe to society, and for the requital of which they have but a short period allowed them. The young should plant for the double purpose of benefiting themselves and their children.

We would by no means advise that the farmer should confine himself to mere ornamental trees. There are many fruit-trees that are not only ornamental but useful, about dwellings, as the cherry, pear, apple, quince, &c.

There is not a spring or an autumn in which a few hours cannot be spared, without detriment to the labors of the farm, to plant out fruit and ornamental trees and shrubbery about the dwelling, and but very few hours are requisite. There is no great art required in the business. The holes for the plants should be dug larger and deeper than the size of the roots, in order that these may be surrounded on all sides by rich surface mould, into which the

new roots may push freely, and find food. The infertile soil from the pit should be thrown away, and its place supplied by mould taken from the surrounding surface; the roots should have their natural direction, and the earth be well pressed upon them; and the plants should be protected from cattle till they are of a size not to be injured by them.

Our attention has been particularly drawn to this subject, by reading the report and the constitution of the Bangor Association, termed, the Ornamental Tree Society, which has been recently formed, and whose object is the embellishment of their city by planting out forest trees. The constitution requires, that "every member shall himself set out, or cause to be set out, one or more ornamental trees, on such of the public streets or squares of the city as he may elect"—the kind of tree, and the distance of planting, to be determined by the directors. Accompanying the report, in the *New England Farmer*, are two letters from General Dearborn, on ornamental planting, evincing much experience and good taste in the matter.

"The monotony of appearance, which lines or clumps of the same tree produce, is to be avoided, and a picturesque and agreeable aspect obtained, by increasing the varieties;\* for as the periods of their foliage are so very different, as well as the tints of green when in vegetation, and the remarkable autumnal changes quite as dissimilar, they are presenting an ever-varying, yet always pleasing and interesting scene. Besides, we have so many magnificent species of native trees, which flourish luxuriantly, even in the most exposed situations, that I have never been able to divine, why one particular tree should be so universally selected, as shades, or for ornament, not only around private dwellings, but for all public places. As well might all flowers be excluded from our gardens but the rose, or the lilach, and all fruits from our orchards but the apple."

"For your streets I recommend the alternate planting

\* The General considers the planting of only one kind of tree as evincing a bad taste.

out of rock maples, elms, white ash, white maple, basswood, beech, and red, white, and other oaks." [We will add to the list of native trees, the buttonwood, the tulip-tree or whitewood, and cucumber-tree, (*Magnolia acuminata*,) for the city and village, and the black walnut, butternut, and honey locust for the country.] "The rock maple is certainly one of our most superb trees, and in my own estimation superior to the elm. Its form and foliage, with the splendid changes of its autumnal aspect, are of surpassing beauty. The basswood (*Tilia Americana*) is the American linden, or lime, and much superior, for its size, graceful form, and large leaves, to the much celebrated and favorite European species. It is easy to transplant, and of rapid growth. The oaks are of rapid growth, and were once as renowned as the name of England. They have been the choice trees of all the celebrated nations of antiquity. The occidental plane, or American buttonwood, is also a finer tree than the oriental variety, which was so much admired and cultivated by the Asiatics and Romans."

For public grounds and squares, the General recommends, also, the white pine, cedar, hemlock, spruce, and we would add the fir, the larch, and a sprinkling of foreign trees, as the English and Scotch elms, larch, abeel, horse chestnut, mountain ash, &c., which may be obtained at the nurseries. He recommends the spring as the best season for transplanting in New England; that the roots be taken up as entire as possible; that the trees be *not more than two inches in diameter*; that the tops be not cut or mutilated;—"Do not," says he, "*cut off a single twig*, save such as may be within four or five feet of the ground." He also directs that large and deep holes be made for the reception of the trees, and that these holes be filled with the best mould, to be well trodden down and watered after the tree is planted. In regard to coniferous and other evergreens, General Dearborn recommends, that they be taken from open grounds—(nurseries are the best)—all the limbs carefully preserved, and as much of the dirt about the roots retained as possible. "The best time," he continues, "to transplant all the

evergreen trees is later than that for the deciduous, and is *just before they commence vegetation.*” These directions are all good ; yet we would amend, or rather add to, the one which regards the *time* for transplanting evergreens. We transplant them *just after vegetation has commenced*—have transplanted in July, with entire success—and our friend, Michael Floy, of New York, a professional nurseryman, prefers the month of August. He showed us, the other day, several large firs, which had been planted at that season, in front of his grounds at Harlem, all of which lived and did well. We think evergreens should be planted *when the tree is growing*—as the foliage requires a constant supply of nourishment through the roots ; and if the functions of these are dormant, as they are likely to be when evergreens are transplanted while vegetation is at rest, the foliage is apt to wither, and the plant to die ; and the only danger to be feared from transplanting these trees at midsummer, is that which arises from excessive evaporation. To guard against this, as much earth should be lifted with the roots as is practicable, the holes for their reception should be large and deep, filled to the proper height for the roots of the tree with loose mould, and well saturated with water ; the surface around the tree should be well mulched with litter, and this well wet, and superficially covered with earth, and the plants occasionally watered if the weather is hot and dry.

As to the effect of planting, *upon the beauty of the landscape*, Mr. A. J. Downing, in a well-written article upon this subject, justly remarks,—

“ Many a dreary and barren prospect may be rendered interesting,—many a natural or artificial deformity hidden, and the effects of almost every landscape may be improved, simply by the judicious employment of trees. The most fertile countries would appear but a desert without them, and the most picturesque scenery in every part of the globe has owed to them its highest charm. Added to this, by the recent improvements in the art of transplanting, the ornamental planter of the present day may realize, almost immediately, what was formerly the slow and regular production of years.”

As to the effect of planting and gardening, *upon the body and mind* of those who engage in these pursuits, we offer the following remarks from Loudon's 'Suburban Gardener,' and we recommend them to the special notice of all gentlemen who are troubled with dyspeptic or hypochondriac affections.

"There is," says an author, "a great deal of enjoyment to be derived, from performing the different operations of gardening, independently of the health resulting from this kind of exercise. To labor for the sake of arriving at a result, and to be successful in attaining it, are, as cause and effect, attended by a certain degree of satisfaction to the mind, however simple or rude the labor may be, and however unimportant the result obtained. To be convinced of this, we have only to imagine ourselves employed in any labor from which no result ensues, but that of fatiguing the body, or wearying the mind; the turning of a wheel, for example, that is connected with no machinery; or, if connected, effects no useful purpose; the carrying a weight from one point to another and back again; or the taking a walk without any object in view, but the negative one of preserving health. Thus it is not only a condition of our nature, that in order to secure health we must labor; but we must also labor in such a way as to produce something useful or agreeable. Now of the different kinds of useful things produced by labor, those things surely which are living beings, and which grow and undergo changes before our eyes, must be more productive of enjoyment than such as are mere brute matter—the kind of labor and other circumstances being the same. Hence, a man who plants a tree, a hedge, or sows a grass-plot in his garden, lays a more certain foundation for enjoyment, than he who builds a wall, or lays down a gravel walk; and hence the enjoyment of a citizen, whose recreation, at his suburban residence, consists in working in his garden, must be higher in the scale, than that of him who amuses himself in the plot around his house, with shooting at a mark, or playing at bowls."

A strong illustration of this truth lately came within our



knowledge. An esteemed friend, who had become wealthy, and retired from active business, at the middle age of life, had become particularly diseased in body and in mind. We advised him to recreate himself in horticultural pursuits, as an antidote to both maladies. He replied, that he had no taste, and could not acquire a relish, for these pursuits. We thought otherwise; and as he was going to spend the summer with a relative, on a farm which belonged to him, we presented him with half a dozen trees, asked him to plant them on his farm, and to report to us in autumn, whether they had afforded him any gratification. When he returned from his summer residence, he confessed, with gratitude, that they had been to him a source of high interest and gratification; that they had received his constant care and attention; that he had watched, with a kind of paternal feeling, the developement of the leaves, and the growth of the branches; that he had examined them almost daily, sedulously guarded them from injury, and watered them with his own hand; and that these cares and labors afforded pleasure without alloy. Had our regretted friend made this experiment two years earlier, he would, in all probability, be now numbered among the living, and probably among the hale and hearty.

But to return to our quotations from Mr. Loudon:—

“One of the greatest of all the sources of enjoyment resulting from the possession of a garden,” remarks our author, “is the endless variety which it produces, either by the perpetual progress of vegetation which is going forward in it to maturity, dormancy, or decay, or by the almost innumerable kinds of plants which may be raised in even the smallest garden. Even the same trees, grown in the same garden, are undergoing perpetual changes throughout the year; and trees change also in every succeeding year, relatively to that which is past; because they become larger and larger as they advance in age, and acquire more and more their characteristic and mature form.” “Independently of the variety of changes resulting from the variety of plants cultivated, every month throughout the year has its particular operations and its products; nay, it would not be too much to say, that

during six months of the year, a change takes place, and is perceptible, in the plants of a garden, every day ; and every day has in consequence its operations and its products.”

In conclusion : A bountiful Providence has given the vegetable kingdom for our sustenance, employment, and highest intellectual enjoyment,—and has scattered these elements of happiness, with a profuse hand, every where within our reach. It is left for us to enjoy them in a greater or less degree, as we learn to appreciate their value, and exert ourselves to apply them to their proper use. The brute is content to satisfy its animal wants. Man, the lord of the creation, should have a higher aim, because he has higher sources of enjoyment than the brute, and higher duties to perform—he is the husbandman appointed to take care of and nurture the great vineyard, and to carry out the purposes of the all-bountiful Giver.

THE  
ADDRESS,  
PREPARED  
TO BE DELIVERED BEFORE  
THE  
AGRICULTURAL AND HORTICULTURAL SOCIETIES  
OF  
NEW HAVEN COUNTY, CONN.  
SEPT. 25, 1839.

For the following Address,—the last prepared by the lamented author,—the publishers are indebted to the kindness of his son, Jesse Buel, Esq., and the Agricultural and Horticultural Societies of New Haven. The subjoined letter will show the interest with which the reading of the Address was listened to by a large and respectable assembly, and the regret felt by them that the author should have been prevented, by sickness, from delivering it himself.

NEW HAVEN, Sept. 26, 1839.

TO JESSE BUEL, Esq.—*Dear Sir,* We have the pleasure of tendering to you the thanks of the AGRICULTURAL and HORTICULTURAL SOCIETIES of New Haven, and of many other citizens, for your excellent Address, which was impressively read yesterday to a large assembly, both from the city and the neighboring towns. We are instructed to say to you, that the discourse was heard with great satisfaction and delight, and that, by a unanimous vote, a copy is requested for publication.

The sentiment was warmly expressed, that a copy ought to be placed in every family in the State, and the only regret manifested by the audience, was, that the respected author should be arrested by sickness in his journey, and that they were thus deprived of listening to one whose bright and successful example, gave such decisive weight to his precepts of wisdom and of real patriotism. It is made the duty of the Committee also to inform Judge BUEL, that the Hon. SIMEON BALDWIN, HENRY WHITNEY, and JAMES BREWSTER, Esqrs., were appointed agents to promote the circulation of the ‘Cultivator,’ and to recommend that useful publication to the public favor, and to a more extensive and efficient patronage in this State.

The Committee beg leave to express their personal satisfaction in the performance of the pleasing duty assigned them, and to add their warmest good wishes for the restoration to health, and for a long course of usefulness, to one who has proved himself a real benefactor to his country.

On behalf of the Agricultural and Horticultural Societies, and of many other citizens.

S. BALDWIN,	} Committee, &c.
B. SILLIMAN,	
ELI IVES,	
J. KNIGHT,	
JAMES BREWSTER,	
A. N. SKINNER,	
HENRY WHITNEY,	

To the above, Judge BUEL replied, assenting to the publication of the Address

## A D D R E S S .

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I APPEAR here, gentlemen, by invitation, to address you on the cultivation of the soil, in which it is the object of the associations here convened to promote improvement. I have been prompted, in the undertaking, rather by a *desire* to render a service, than from a confidence in my *ability* to perform one ; and in the few remarks I have to offer, shall need much of your indulgence, for defect in style, and deficiency in matter.

Agriculture and Horticulture are intimately related to each other. They both depend upon the soil, and the animals and plants which it nurtures, for support, for profit, and for pleasure. They both administer, and are indispensable, to our wants and comforts. They are governed in their operations by the same natural laws. Agriculture has cognizance of the farm, which supplies our principal wants ; Horticulture, of the garden, which administers to our more refined appetites, to our health, and to the rational pleasures of mind. The one gives us bread and meat, and the materials for our clothing ; the other gives us the choice delicacies for the table, and multiplies around us the charms of floral beauty, and rural scenery. Both tend to beget habits of useful industry and sober reflection, and to improve us in all the social relations of life. It is befitting, therefore, that institutions designed to foster and promote improvements in these primary and associate branches of labor, should unite in their anniversary celebration, and in returning thanks to the Supreme Being, for the bounties of a fruitful season.

Of the utility of these celebrations, and exhibition of the products of the farm and garden which are made at them, I have no kind of doubt. They bring to public

notice whatever is new and most valuable, in a business which highly interests us. They perform the work of years, in diffusing useful knowledge in all the departments of rural labor. They awaken, in the bosoms of hundreds, the dormant powers of the mind, which otherwise might have slumbered in apathy. They excite to industry, to emulation, and to the study of those laws which every where control the visible creation, and which enlighten and reward all who humbly seek and follow their counsels. Nor is it the cultivator of the farm and garden alone that are to be benefited by these exhibitions. Whatever tends to increase and improve the products of the soil, serves to augment the common stock, and enables the grower to supply the market with more and better products, and to buy more liberally of the other classes in return. The merchant, the manufacturer, the mechanic, and the professional man, have all, therefore, as deep an interest in promoting the improvement of agriculture and horticulture, as the farmer and gardener have. Society is in some measure a joint concern, at least so far as relates to what are termed the producing classes ; the more these earn by their labor, the greater is the accession of substantial wealth to the community. The amount of honey in a hive, depends not upon the number of bees which it contains, but upon the labor and skill of the *working* bees. The farmer virtually provides for the other classes, and is at the same time their principal patron and customer ; and although his labors are too often held to be low and menial, by those who cannot, or will not appreciate their value, his condition affords the best criterion by which to judge of the welfare of those around him. No *country* can long flourish, or preserve its moral and physical health, whose agriculture is neglected and degraded. The amount of a farmer's sales, and of his purchases, will depend upon the surplus products of his farm, and upon the profits of his labor. Double these, by an improved system of husbandry, which I feel assured can be done, and which has been far more than realized, in many old districts of our country, and you will double the substantial wealth of the neighborhood, and

impart corresponding life and activity to every other department of business. If we look to Spain, to Portugal, to a great portion of Italy, to South America, or any other country where agriculture is neglected, or holds but a subordinate rank, we shall find a degraded population, characterized by superstitious ignorance, poverty, and crime. Every class of the community, therefore, has a deep interest in promoting the improvement of the soil; and all should willingly contribute their aid towards enlightening, honoring, and rewarding those who are honestly employed in its cultivation.

With regard to the utility of Agricultural and Horticultural Societies, much will depend upon the objects which bring together their members. If they associate for selfish purposes, merely to monopolize the spoils, and withdraw whenever they are disappointed in their sinister hopes, jealousies and apathy will ensue, and the association will fall, as many under like circumstances have fallen, without public loss or public regret. But if the association is formed for mutual improvement, and in the benevolent and patriotic desire to do a public good,—to stimulate and reward industry and enterprise, however humble their condition,—and strives, by concentrated and persevering efforts, to improve the condition of a district, of a county, or a State,—then will it inspire public confidence, obtain public support, and become a public blessing. To illustrate this last proposition, I beg to refer to some associations which have been tried, and whose labors have been crowned with palpable and brilliant success.

The counties of Berkshire, Essex, and Worcester, in Massachusetts, have each, for many years, maintained an Agricultural Society; and they each distribute ten or twelve hundred dollars a year, one half of which is paid out of the State treasury, in prizes to successful competitors in the various departments of agricultural and household labor. It is said, and I believe with truth, that every dollar thus expended, has made a return of twenty dollars, in the increase of agricultural products which it has caused; and so satisfied are the inhabitants of the

benefits of the expenditure, that an increased spirit is annually manifested, by all classes, to maintain and perpetuate these nurseries of industry and improvement.

The Highland Society of Scotland affords another illustrious example of the utility of agricultural associations, when conducted with a view to public improvement. This society was organized in 1784, but so few were its members, and so limited its means, that it attracted but little public notice, nor effected any great improvement in husbandry, till the commencement of the nineteenth century. Yet it had sown the good seed which never fails, under proper management, to yield to the husbandman a bountiful harvest. Nor did it fail in this case. The society now numbers twenty-two hundred members, embracing most of the opulent and influential men of the country, of all professions, and distributes annually in prizes, about seventeen thousand dollars. In no country or district has agriculture made more rapid strides in improvement, than it has in Scotland, since the organization of this society ; and although it may not have been the only, it most assuredly has been a principal cause, of this wonderful and salutary change. Up to 1792, the agriculture of Scotland, to adopt the language of the Edinburgh Quarterly Journal of Agriculture, was “wretched—excrably bad, in all its localities ! Hardly any wheat was attempted to be grown ; oats full of thistles was the standard crop, and this was repeated on the greater part of the arable land, while it would produce twice the seed thrown into it ; turnips, as part of the rotation of crops, was unknown, few potatoes were raised, and no grass-seeds or clover were sown. A great part of the summer was employed, in the now fertile shire of Fife, in pulling thistles out of the oats, and bringing them home for the horses, or mowing the rushes, or other aquatic plants, that grew on the bogs, around the homestead.” But a change soon came over the land. The seed which had been sown by the Highland Society had germinated, and its luxuriant foliage already covered the soil. In 1815, according to the authority I am quoting, “beautiful fields of wheat were to be seen ; drilled green crops



every where abounded ; the bogs had disappeared ; the thistles no longer existed ;” naked fallows were abolished ; draining was extensively introduced ; wet lands were made dry ; poor weeping clays were converted into turnip soils ; and “ whole parishes were completely transformed from unsightly marshes, into beautiful and rich wheat-fields ; and where the plough could scarcely be driven for slush and water, were heavy crops per acre, and heavy weight per bushel.”\* The improvements in Scotch husbandry have continued to advance, until, according to the estimate of Sir John Sinclair, and Professor Lowe, both high authority,—until the acreable products of her soil more than double those of our Atlantic States.

The means adopted by the Highland Society to effect these radical improvements in Scotch husbandry, are such as may be employed by us with almost a certainty of corresponding success. “ In the days of its youth and feebleness,” says the Quarterly Journal I have just quoted, “ the Highland Society sent the leaven of the turnip husbandry into all the glens and straths of the north, by offers of small prizes to certain Highland parishes, and the same may be said as to the growth of clover and the finer grasses. As it advanced in strength, as to numbers, and to cash, attention was turned to premiums for stock ; then came offers of reward to men of science to discover better implements and machines, to diminish friction, and consequently draught, such as in the threshing-mill, and other parts of agricultural machinery. Still advancing in the scale of intellect and of science, premiums were offered for essays to bring to light the facts connected with chemistry and natural philosophy ; and, under the auspices of the society, was set up the Quarterly Journal of Agriculture, a work which has been the vehicle of conveying so much useful information to the agriculturist, that we humbly venture to say, it ought to appear on the book-shelf and table of every farmer’s parlor. After this, the great stock-shows were resolved upon.” At the

\* Quarterly Jour. Ag. for June, 1839, p. 70.

Glasgow show in 1838, there were exhibited for prizes, 461 neat cattle, 121 horses, 274 sheep, and 47 swine, total 903 domestic animals, in 634 lots. Of the other kinds of competitors, the numbers were as follows :

For Butter,	-	-	-	-	18
“ Full Milk Cheese,	-	-	-	-	15
“ Skim Milk Cheese,	-	-	-	-	6
“ Wool,	-	-	-	-	8
“ Roots and Seeds,	-	-	-	-	13
“ Implements,	-	-	-	-	28

—  
In 88 lots.

The number of persons present at the exhibition, was estimated at over 17,000, besides workmen and official people;—not one in a thousand of whom probably left the exhibition without carrying home with him some newly acquired knowledge in his business, or some new stimulus to improvement and industry. Not only has Scotland profited by the labors of her Agricultural Society, but Great Britain generally, and even the United States have been highly benefited by them. The information which that Society has promulgated, has been widely disseminated among us by our agricultural journals, and has contributed not a little to the improvement of the agriculture of our country. And in England, which had been thrown into the back-ground by the superior improvement of Scotch husbandry, it has, within the last year, induced the formation of the English Agricultural Society, on a broad and liberal scale, which promises important advantages to English husbandry, and to agriculture generally.

As evidence of the utility of Horticultural Societies in multiplying and improving the products of our gardens, and in promoting rural embellishments, I would refer to the neighborhoods of Boston and Philadelphia, where societies of this kind have long existed, and to the Horticultural Society of London. In the first-named cities, and their environs, the progress of horticultural improvement has been manifestly great. Many new and choice fruits, culinary vegetables, and ornamental plants, have

been introduced, culture has been much improved, the markets better supplied, and prices cheapened. The London Society, although its garden has been established but about twenty years, has concentrated in it, from both continents, and from the islands of the sea, embracing every clime, more than five thousand varieties of edible fruits, including fourteen hundred varieties of the apple, and seven hundred of the pear, and an innumerable number of ornamental plants, many of them before unknown in our catalogues. Its collection of pears, which embrace hundreds of recent origin, from Flanders and from France, have been already broadly spread over these States, and supply our dessert with a succession of this delicious fruit. As a corresponding member of this Society, I have participated, and have enabled others to participate, in the good which it has been generously diffusing abroad. In 1825, and at subsequent periods, I have been supplied liberally with grafts of the choicest fruits which it had collected.

The greatest obstacles to Horticultural improvement, are, ignorance of the relative merits of different kinds of fruits and culinary vegetables, and of the proper modes of cultivating and preparing them for the table. The generality of country gardens exhibit but a scanty assortment of vegetable productions, and these are but badly cultivated, and often of inferior quality. The tendency of Horticultural exhibitions is, to show the good and bad in contrast, or rather to promulgate a knowledge of the better sorts, of their culture and use, to excite useful competition, and to demonstrate the utility of garden culture, as a source of health, pleasure, and profit. I have had many fruits presented to me, which the donors considered of the first quality, but which I found, on comparison, to be of secondary, or inferior grade. The man who has seen or tasted only inferior fruits, may well mistake them for good ones. It is as easy to cultivate good fruits as bad ones; and no one eats so good fruits as he who cultivates them himself. It is as easy to cultivate the vergaleu as it is the choke pear; the green gage as the horse plum; and yet the difference between them, in

all the qualities which we most esteem, is incomparably great. But till we can show our neighbor better fruits, he will continue to cultivate, and rest content with, his choke pear and horse plum.

With regard to what is termed ornamental gardening, or the cultivation of flowering shrubs and plants, there is an objection, real or affected, often made by very many people, on the ground that it yields no profit. If the great object of life was to accumulate money, without enjoying any of the comforts which it confers, save the gratification of animal appetite, the objection would be conclusive. But we are endowed with other and higher appetites than the mere brute ; and Providence has every where surrounded us with suitable objects for their developement, and innocent gratification. And shall we reject the proffered benefaction so kindly tendered for our benefit, because it adds nothing to our pelf ? And what is there in the natural creation, better calculated to soften down the rough asperities of our nature, to awaken kind feelings towards each other, and excite reverence and love for the Most High, than a familiar acquaintance with the wonders and beauties of his vegetable kingdom. Did you ever know a misanthrope, or a miser, who was an admirer of flowers ? I would not recommend the neglect of more important duties, for the culture of a flower-garden : yet when there is ability or leisure, and these may be found to a greater or less extent in almost every family, a taste for floral beauties should be inculcated in the young, not only as a source of rational pleasure, but as a salutary precaution against bad companions and bad habits. The mind must be employed, and must have recreation. It is better to direct it to the works of the Creator, than to the works of man. Lord Bacon has said of the garden, “ It affords the purest of human pleasures—the greatest refreshment to the spirits of man—without which, buildings and palaces are but gross handiworks.”

But I am forgetting myself. In my ardor to commend Horticulture, for its useful, elevating, and purifying influence upon the habits and manners of society, I did not recollect that I am addressing the highly polished inhab-

itants of a classic city,\* who have long since demonstrated, in practice, the truth of the lessons I would inculcate. I will therefore dismiss this branch of my subject, and turn to the more rugged, though not less important, topic of Agriculture ; barely adding,—

That in all endeavors to improve the condition of society, whether religious, moral, or industrial, individual efforts and example can effect but little ; and hence, that in every great work of reform or improvement, the concentrated strength of many has been resorted to, and brought to a focus, by means of associations ; and that the great objects of society are not likely to be promoted in a more eminent degree, by any, than by associations formed for like purposes with those which I have now the honor to address.

Being a native of this State, and having spent my early days within its borders, I can well remember the farming practices that were wont to prevail. The farm was, to use the commendatory language of that day, “ suitably divided into meadow, pasture, and plough land,” and each division was exclusively devoted to its object, until most of the nutritious grasses had “ *run out*,” in the meadow, and the plough land had become too much impoverished to bear a remunerating crop. Many an acre was turned into “ *old field*,” or commons, destitute alike of natural or artificial herbage, affording scanty gleanings to half-famished cattle. I beg not to be misunderstood. I am describing what *was* a bad feature in Yankee husbandry. Farming has no doubt recently undergone great improvements in Connecticut, as it has elsewhere. Yet on a fair comparison with highly-cultivated agricultural districts, I believe that it will be found that the husbandry of this State, in the main, is susceptible of great improvement. The lands of Connecticut were originally rich and productive. The earthy elements remain in a great measure unchanged ; the seasons are about as propitious as they were wont to be ; and the lessons in improvement that have been taught elsewhere, leave little reason to doubt,

\* New Haven.

that under proper management, they may again be restored to their original fertility.

In a late tour which I made through parts of New York and New Jersey, I found many evidences of recent improvement, and I doubt not similar ones abound in my native State. In a part of Dutchess County, which I visited, the best farms have been sold, within my recollection, with improvements and buildings, at from seven to seventeen dollars an acre. They cannot now be bought for one hundred dollars an acre; and one was sold last year at auction, without buildings, at one hundred and thirty dollars an acre. Fifteen years ago, a farm in western New York, of 400 acres, exhausted by bad husbandry, was bought by a Scotch farmer for \$4000. This farm has been so improved by good husbandry, that the owner was last year offered for it \$40,000. He refused the offer, upon the ground, that it actually netted him the interest of \$60,000, or \$10 50 the acre. A farm was pointed out to me in New Jersey, which was recently sold for seven dollars the acre, and that was all it was said to have been worth in its then condition. By a liberal outlay in draining, it being level and wet ground, and in liming, manuring, &c., it is now considered worth one hundred and twenty-five dollars an acre. I went over another farm which a few years ago was bought at the same price, and which now, on account of the improvements which have been made upon it, is considered worth one hundred dollars per acre. I am informed on the best authority, that similar cases of the rapid increase in the products and value of farms, consequent upon an improved system of management, are to be found in Pennsylvania, Delaware, and Maryland. Although these cases are isolated ones, they nevertheless serve to show the practicability of vastly increasing the value and products of our exhausted lands.

Among the causes which have essentially contributed to the deterioration of our lands, and the consequent depression of our Agriculture, I consider the following as prominent :

Ignorance of the *principles* of Agriculture ;

The want of a sufficient outlay in the management of our farms ; and

The low estimation in which the employment has been held by all classes, including farmers themselves.

Agriculture has too generally been considered a business requiring mere physical power, with which the principles of natural science had little or nothing to do. To plough, sow, and gather the crop, has been the general routine of farming operations, regardless of the poverty which our practice was inflicting upon the soil and upon our children. Like the reckless heir of wealth, we found ourselves in possession of a treasure ; and without inquiring for what purpose it came into our hands, or realizing our obligations to husband and preserve it, for others, we have squandered it lavishly, through our ignorance or our folly. True, we have been occasionally admonished of our error, by the schoolmen ; who, wrapped in abstract science, and knowing little practically of its application to husbandry, have as often tended to confuse and mystify, as to enlighten and instruct. Hence the prejudice which has arisen, against book-farming. But science and art are now uniting their labors, and are deriving mutual aid from each other, on the farm, as they have for some time been doing in the manufactory and in the shop of the artisan. A new era is dawning upon the vision of the farmer ; a new light is illuming his path, and a new interest and new pleasures are urging him on to improvement. He begins to study the laws which Providence has ordained for the government of improved culture, and he finds, in their application to his labors, the means of increasing profits and high intellectual enjoyment. And the more he studies and is guided by these laws, the more does he become satisfied of former errors, and of his comparatively limited sphere of usefulness. Science is probably capable of rendering more important services to husbandry than to any other branch of labor, and presents a wider field of useful study to the cultivator of the soil, than to any other class of society.

The deficiency in farming capital, or rather the stinginess with which capital is employed in improving and

maintaining the condition of our lands, is another cause of declension in the profits and character of our Agriculture. The farmer is too prone to invest his surplus means in some new business, or in adding to his acres, instead of applying them to increase the profits of his labor and the products of his farm. He either works more land than he can work well and profitably, or he diverts to other objects the means which would yield a better return if applied to the improvement of the farm. He is apt to consider twenty or thirty dollars an enormous and wasteful outlay upon an acre of land, or upon a choice animal; and yet the interest of this outlay will be ten times paid by the increase of crop or the increase of the animal; and in most cases the principal also will be returned to him in the course of two or three years. Many of the most thriving farmers in southern New York, New Jersey, and Pennsylvania, make a quadrennial expenditure of twenty dollars or more to manure an acre; and it has become a maxim with them, that the more the outlay for manure, the greater the net profit of their lands. But it is not the outlay for manure alone, that demands a liberal expenditure of capital. Good seed, good farm-stock, and good implements, are all essential to the economy of labor, and to neat and profitable farming. And I think it will appear from the cases I have quoted, that in many locations, capital may be very advantageously employed, in reclaiming wet and marshy grounds, generally rich and the most productive when laid dry.

When our cattle grow lean, and threaten to disappoint our hopes of profit, we do not hesitate to impute the evil to the want of food, or to inattention in the herdsman. And if we are prudent managers, we at once graduate our stock to our food, knowing that one well-fed animal is of more value in the market, than two animals that carry but skin and bones, and take care that the food is properly fed out. When our crops become lean, we need not hesitate to ascribe the decrease in product to like causes—want of food, or want of attention in the farmer; and prudence and profit in like manner require, that our crops, like our animals, should be limited to the food and labor



which we have to bestow upon them. In other words, an acre well manured and well worked, will be found to be more profitable, than four poor acres badly worked.

I may be here asked, whence are to be obtained the vast supplies of manure requisite to manure our old lands? I answer, from a multiplicity of sources around us, from every animal and vegetable substance within our reach. Nothing that has once been part of an animal or a vegetable, but can be converted into corn, grass, and roots. I think I may assume as facts, that upon an average, not half the manure is saved upon our farms that might be, and that this moiety is half lost before it is applied to the soil. Every horse, ox, or cow, wintered upon the farm, if well fed, and littered with the straw, stalks, &c., of the crop, should make from six to ten cords of good manure. Dr. Coventry, late Professor of Agriculture at Edinburgh, estimated that the straw of an ordinary acre of grain, computed at 21 cwt., may be converted by the urine and liquids of the stables and cattle-yards, into three and a half tons of manure; that meadows which cut one and a half tons of hay will give four tons of manure; clover, the first year, six tons, and the second year, five and a half tons per acre; and that with the extraneous substances which may, with due care, be collected without expense from the roads, the ditches, the ponds, and from refuse of every kind about the house and premises, the acreable amount should be amply sufficient for a full supply of manure once during every course of the four-year system of husbandry. Arthur Young, with 6 horses, 4 cows, and 9 hogs, which consumed 16 loads of hay and 29 loads of straw, obtained 118 loads of manure, 36 bushels to each; and from 45 fattening oxen, well fed and littered, 600 tons of rotten manure. But an American lawyer,\* and an excellent practical farmer withal, has gone beyond these estimates. I visited, a few weeks ago, his farm, which lies upon the sea-shore. It consists of about 200 acres, most of which was in a course of crops. The crops of the season had all received an ample supply

\* W. A. Seeley, Esq., of Staten Island.

of manure, as their appearance indicated ; and yet I was shown masses of well-prepared compost, in reserve, consisting of yard manure, peat ashes, peat earth, sea-weed, and fish—estimated at twenty-five hundred loads—*all produced upon his own farm.*

The third obstacle to Agricultural improvement, which I propose to notice, is the subordinate rank to which this employment has been consigned, and to which the farmers themselves have contributed, by a want of respect for themselves and respect for their vocation. The wholesome habits of society have been so broken up, by the civil and political convulsions of the age, and the inordinate thirst for acquiring wealth and fashionable consequence, through mercantile and other speculations, that honest productive labor has been thrown entirely into the back-ground, and considered not only ungentle, but menial and servile. Yet I venture to lay down this proposition, that he who provides for the wants and comforts of himself and family, and renders some service to society at large, by his mental and physical industry, performs one of the high duties of life ; and will ultimately be rewarded in the conscious rectitude of his life, by a greater measure of substantial happiness, than he who makes millions by fraud and speculation, to be squandered in extravagance or wasted in folly, by his children or grandchildren. The revolutions which are constantly taking place in families, sufficiently admonish us, that it is not the wealth we leave to our children, but the industrial and moral habits in which we educate them, that secures to them worldly prosperity, and the treasure of an approving conscience.

The farmers, I have remarked, share in the errors of the day. Not content with the gains which are ever the reward of prudent industry, and which might be greatly increased by the culture of the mind ; nor content with one of the most independent conditions in society, hundreds and thousands of them seek other and new employments, and some of truly menial character, to get rid of labor, the greatest blessing to man, and to raise themselves in the imaginary scale of fashionable society. And if they cannot participate, themselves, in this imaginary

greatness, (and it is seldom any thing more than imaginary,) they are anxious to inflict the evil upon their posterity, —to rear their sons to the law, the rail-road to office, to political power, and turmoil ; to make them merchants, a useful, but greatly over-stocked business, or to place them in some other genteel employment, which shall exempt them from the toils of labor, the salt that best preserves from moral corruption.

Mistaken men ! What class in society have within their reach so many of the elements of human enjoyments —so many facilities for dispensing benefits to others, one of the first duties and richest pleasures of life—as the independent tillers of the soil ? “ The farmer,” says Franklin, “ has no need of popular favor ; the success of his crops depends only on the blessing of God upon his honest industry.” If discreetly conducted on the improved principles of husbandry, Agriculture offers the certain means of acquiring wealth, and as rapidly as is consistent with the pure enjoyments of life, or with the good order and prosperous condition of society. Agriculture is the golden mean, secure alike from the temptations of mushroom opulence, and the craven sycophancy and dependance of poverty. “ Give me neither poverty nor riches,” was the prayer of the wise man of Scripture, “ lest,” he added, “ I be full and deny thee, and say, who is the Lord ? or lest I be poor, and steal, and take the name of my God in vain.”

When we consider that Agriculture is the great business of the nation—of mankind ; that its successful prosecution depends upon a knowledge in the cultivators of the soil, of the principles of natural science,—and that *our* Agriculture stands in special need of this auxiliary aid,—we cannot withhold our surprise and regret, that we have not long since established professional schools, in which our youth, or such of them as are designed to manage this branch of national labor, might be taught, simultaneously, the principles and practice of their future business of life, and on which, more than any other branch of business, the fortunes of our country, moral, political, and national, essentially depend. We require an initiatory study of

years in the principles of law and medicine, before we permit the pupil to practise in these professions. We require a like preliminary study in our military and naval schools, in the sciences of war and navigation, ere the student is deemed qualified to command. And yet, in Agriculture, by which, under the blessing of Providence, we virtually "live, and move, and have our being," and which truly embraces a wider range of useful science than either law, medicine, war, or navigation, we have no schools, we give no instruction, we bestow no governmental patronage. Scientific knowledge is deemed indispensable in many minor employments of life; but in this great business, in which its influence would be most potent and useful, we consider it, judging from our practice, of less consequence than the fictions of the novelist. We regard mind as the efficient power in most other pursuits; while we forget, that in Agriculture, it is the Archimedean lever, which, though it does not *move*, tends to *fill* a world with plenty, with moral health, and human happiness. Can it excite surprise, that under these circumstances of gross neglect, Agriculture should have become among us, in popular estimation, a clownish and ignoble employment?

In the absence of Agricultural professional schools, could we not do much to enlighten and raise the character of American husbandry, by making its principles a branch of study in our district schools? This knowledge would seldom come amiss, and it would often prove a ready help under misfortune, to those who had failed in other business. What man is there, who may not expect, at some time of life, to profit directly by a knowledge of these principles? Who does not hope to become the owner, or cultivator, of a garden, or a farm? And what man, enjoying the blessing of health, would be at a loss for the means of an honest livelihood, whose mind had been early imbued with the philosophy of rural culture—and who would rather work than beg?

An early acquaintance with natural science is calculated to beget a taste for rural life and rural labors, as a source of pleasure, profit, and honor. It will stimulate to the

improvement of the mind,—to elevate and to purify it,—to self-respect, to moral deportment. And it will tend to deter from the formation of bad habits, which steal upon the ignorant and the idle unawares, and which consign thousands of young men to poverty and disgrace, if not to premature graves. A knowledge of these principles, to a very useful extent, can be acquired with as much facility in the school, or upon the farm, as other branches of learning. Why, then, shall they not be taught? Why shall we withhold from our Agricultural population that knowledge which is so indispensable to their profit, to their independence, and to their correct bearing as freemen? Why, while we boast of our superior privileges, keep in comparative ignorance of their business, that class of our citizens who are truly the conservators of our freedom? I know of but one objection,—the want of teachers. A few years ago, civil engineers were not to be found among us. The demand for them created a supply. We have demonstrated that we have the materials for civil engineers, and that we can work them up. We have materials for teachers of Agricultural science, which we can also work up. Demand will always insure a supply.

The enumeration of the foregoing obstacles to Agricultural improvement, sufficiently indicates the means which will be efficient in removing them. The means consist, so far as I now propose to notice them—

1. In giving a *professional* education to the young farmer, which shall embrace the *principles* and the *practice* of the business which he is designed to follow in life; and,
2. In diffusing, more extensively, among those who have completed their juvenile studies, and are better fitted to profit by the lessons of wisdom and experience, a knowledge of the same principles, and of the best modes of practice which these principles inculcate, and which experience has proved to be sound.

We have professional schools in almost every business of life, except in the cultivation of the soil, one of the most important and essential of them all, and one embracing a larger scope of useful study in natural science,

and in usefulness to the temporal wants of the human family, than any other. The policy of monarchs, and of privileged orders, has been to repress intelligence in the Agricultural mass, in order to keep them in a subordinate station. But neither the policy nor the practice should be countenanced by us. Our Agriculturists are our privileged class, if we have such. They are our sovereigns, because, from their superior numbers, they must ever control our political destinies, for good or for evil. And the more intelligent and independent we can render them, the more safe we make our country from the convulsions of internal feuds, and the danger of foreign war.

I put the question to fathers—Would you esteem that son less, or think him less likely to fulfil the great duties of life, who had been educated in a professional school of Agriculture, with all the high qualifications which it would confer for public and domestic usefulness, than him who had been educated for the counter, the bar, or other high professional callings? On which could you best rely for support and comfort in the decline of life? Nay, I will venture to carry the appeal further—to the discriminating judgement of the unmarried lady—Would you reject, as a partner for life, the student of such a college, coming forth with a sound mind, deeply imbued with useful knowledge, and a hale constitution, invigorated by manly exercise, whose cares and affections were likely to be concentrated upon home and country, and whose precepts and examples would tend to diffuse industry, prosperity, and rural happiness around him? The father's response would be, I think, an unhesitating no, to the first question; and the lady's, after due deliberation, I verily suspect, would be a half articulate amen! I pretend not to the spirit of prophecy, yet I venture to predict, that many who now hear me, will live to see professional schools of Agriculture established in our land, to see their utility extolled, and to be induced to consider them the best nurseries for republican virtues, and the surest guaranty for the perpetuity of our liberties. They should be established—they will be established—and the sooner they are established, the better for our country.

To those who have passed to manhood, and who have made up their minds, from necessity or from choice, to till the ground, the means of improvement—of studying the principles of their business, and of becoming acquainted with the most approved and modern practices in husbandry—the opportunities of acquiring useful knowledge, are abundant and cheap. One of these means, and a valuable one, is proffered him through the exhibitions and publications of these societies. Another is the perusal of books upon Agriculture and rural economy, which should form a part of social and rural libraries. And another facility of acquiring this useful knowledge, is afforded by the Agricultural periodicals of our country, which, besides containing much that is instructive in the philosophy of farming, are a record of the best modes of practice, and of much that is new and important, in the various departments of rural and household labor. A volume of the *Cultivator*, of which I can speak with accuracy, contains about as much matter as five or six volumes of the popular novels of the day, and twice as much as four numbers of our literary quarterly journals. The price of the *Cultivator* is one dollar per annum. I verily think, that if the farmer would divide his patronage between political and Agricultural journals, he would be a manifest gainer, in his fortune and in his family—would be more happy in his business, and domestic in his habits—a better manager, and a more useful citizen.

Time will not permit me to go into the details of modern improvements in husbandry. These improvements are great, and afford the brightest hopes to the philanthropist and the patriot. No one who can carry back his memory forty years, can withhold his wonder at the astonishing improvements which have in that time been made in the manufacturing and mechanic arts, by reason of the aids of science ; and those who can scan the future, will have no less reason to rejoice, in the anticipated advantages which are in prospect, from an improved culture of the mind and the soil, consequent upon a better system of education to the agricultural population, and the gen-

eral diffusion of useful knowledge, which is likely to result from it.

I will merely further remark to the farmer, that if he would prosper in his business, he should study, practise, and adopt, the better system of husbandry which is abroad in the land, and which has already greatly profited thousands, so far as his soil and circumstances will permit ; that he should drain his wet lands, economize his manures, and apply them with judgement ; cultivate well, what he does cultivate ; alternate his crops ; extend his root culture ; increase and improve his stock, as the products of his farm will permit ; and substitute fallow crops for naked fallows.

In conclusion, gentlemen, permit me to express my hearty wish, that success and honor may crown your efforts to improve the condition of your country, industrial and moral, associate benefits almost as intimately connected as cause and effect ; and that you may long live to enjoy the blessings which are promised to him who truly loves his neighbor, and reveres and worships his God.



## APPENDIX.

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### COLLECTIONS OF FACTS.

#### MATHEMATICS AND PHYSICS.

If the square of the diameter of a circle be multiplied by .7854, the product is the area. If the diameter of a sphere be cubed and multiplied by .6236, the product is the solidity ; and the square of the diameter, multiplied by 3.14159, is the surface of the sphere.

To find the contents of a cask, add double the square of the bung diameter to the square of the head diameter, and multiply this sum by the head of the cask ; then divide the product by 1,077 for ale gallons of 280 cubic inches each, or by 882 for wine gallons of 231 cubic inches each.

Quincunx is one at each of four corners, and one in the middle, thus,  $\therefore$  :

The convexity of the earth interposes to prevent the sight of distant bodies. Thus, at 600 yards, one inch would be concealed, or an object one inch high would not be seen in a straight line ; at 900 yards, two inches ; at 1,400 yards, five inches ; at one mile, eight inches ; three miles, six feet , four miles, ten feet ; five miles, sixteen feet ; six miles, twenty-four feet ; ten miles, sixty-six feet ; twelve miles, ninety-five feet ; thirteen miles, one hundred and twelve feet, and fourteen miles, one hundred and thirty feet.

The mechanical powers may be reduced to three, but they are usually expressed as six—the lever, the wheel and axle, the pulley, the inclined plane, the screw, and the wedge.

In a single moveable pulley, the power gained is double. In a continued combination, the power is twice the number of pulleys, less 1.

In levers, the power is reciprocally as the lengths are each side of the fulcrum or centre of motion, as illustrated in the steelyard.

The power gained in the wheel and axle is as the radius of the wheel to that of the axle.

The power gained by an inclined plane is as the length to the height.

The power of the wedge is generally as the length to the thickness of the back.

The power of the screw is as the circumference to the distance of the thread, or as 6.2832 to that distance.

Resistance is an affair of experiment, sometimes a third, and at other times less.

The friction of cylinders or wheels is as the pressure, and inversely as the diameter.

The least friction is when polished iron moves on brass.

The area of a circle is the product of the diameter and circumference, divided by 4.

A fall of one tenth of an inch per mile, will produce a motion in rivers. The greatest velocity is at the surface and in the middle, and the least at the bottom and sides. But as the velocity increases, the action on the sides and bottom increases also.

Eclipses return in the very same order every 18 years and 11 days, supposing four leap years in the interval, and if five, then every 10 days. Other cycles of motion, however, vary the phenomenon or measure. The moon's shadow is less than 170 miles broad; but the eclipse, in degree, for 2,000 miles.

A pump ten feet above a well, with seven inches bore, will discharge 70 gallons a minute; and at 30 feet 4 inches, 23 gallons.

The specific gravity of water being 1.000, that of alcohol, pure, is 0.829; beer, 1.034; cider, 1.018; milk, 1.032; linseed oil, 0.94; vinegar, 1.025; sea-water, 1.026; ox bone, 1.666; brass, 7.824; brick, 2.; cork, 0.24; gold, 19.2587; granite, 2.728; bar iron, 7.68; lead, 11.352; lignum-vitæ, 1.33; mahogany, 1.06; marble, 2.716; mercury, 13.58; oak, 1.17; platina, 20.722; silver, 10.474; clay-slate, 2.67; tin, 10.717, limestone, 1.386; elm, 0.671; honey, 1.45.—*Treasury of Knowledge.*

#### MEASURES OF LENGTH.

Measures of length are the distance of one object from another, according to some agreed standard.

A line is the twelfth of an inch, and the 144th of a foot.

A geometrical pace is 4.4 feet English ; and an English mile contains 1,200 paces, or 1,760 yards, or 5,280 feet.

A Scotch mile contains 1,500 paces ; a German mile 4,000 ; a Swedish and Danish mile 5,000 ; the Russian mile 750.

A hand, used in measuring the height of horses, is 4 inches.

A surveyor's chain is 4 poles, or 66 feet, divided into 100 links of 7.92 inches. A square chain is 16 poles, and 10 square chains are an acre. 640 square acres are a square mile ; and 4,840 square yards are an acre, 69.58 yards each way.

The Irish acre is 7,840 square yards.

The Scotch acre is 1.27 English.

A French arpent is  $\frac{5}{8}$  of an English acre.

121 Irish acres are equal to 196 English.

48 Scotch acres are equal to 61 English.

11 Irish miles are equal to 14 English.

80 Scotch miles are equal to 91 English.

A sea league is 3.4536 miles, or the 20th of a degree. 6,078 feet are a sea mile.

A degree at the equator is 365,101 feet, or 69.148 miles, or  $69\frac{1}{7}$  nearly. In latitude  $66^{\circ} 20'$ , Maupertuis measured a degree of latitude, in 1737, and made it 69.403 ; and Swanberg, in 1803, made it 69.292. At the equator, in 1744, four astronomers made it 68.732 ; and Lambton, in 1803, latitude  $12^{\circ}$ , 68.743. Mudge, in England, made it 69.148. Cassini, in France, in 1718 and 1740, made it 69.12, and Biot, 68.769 ; while a recent measure in Spain, makes it but 68.63, which is less than at the equator, and contradicts all the others, proving the earth to be a prolate spheroid, which was the opinion of Cassini, Bernouilli, Euler, and others, while it has more generally been regarded as an oblate spheroid.

Degrees of longitude are to each other in length, as the cosines of their latitudes. For every  $10^{\circ}$  they are as follows :—

Equator, . . . . .	69.2	50° . . . . .	44.48
10° . . . . .	68.15	55° . . . . .	39.69
20° . . . . .	65.27	60° . . . . .	34.6
30° . . . . .	59.93	70° . . . . .	23.67
40° . . . . .	53.1	80° . . . . .	12.02

The pendulum which vibrates seconds, 39.1393 inches

at London, is the standard for the British measures. One mile is equal to 1,618.833 such pendulums.

## WEIGHTS.

The standard of weights, is, the cubic inch of distilled water, weighing 253.458 Troy grains; the Troy pound, 5,760 grains, or 22.8157 inches. The same standard of 7,000 Troy grains, makes the pound avoirdupois, 27.7274 cubic inches; ten of which, or 277.274, being the imperial gallon, or a quart 69.32; and a gill of five ounces of water, equal to 8.664.

The American quintal is 100 pounds.

The weight of a cubic inch of distilled water, in a vacuum, is 252.722 grains, and in air, is 252.458 grains.

The Turkish pound is 7,578 grains; the Danish, 6,941; the Irish, 7,774; the Neapolitan, 4,952; the Scotch, pound Troy, 7,620.8.

A cubic foot of loose earth or sand weighs 95 pounds.

A cubic foot of common soil weighs 124 pounds.

“	“	strong soil,	“	127	“
“	“	clay,	“	135	“
“	“	mason's work,	“	205	“
“	“	distilled water,	“	62.5	“
“	“	cast iron,	“	450.45	“
“	“	steel,	“	489.8	“
“	“	lead,	“	709.5	“
“	“	platina,	“	1,218.75	“
“	“	copper,	“	486.75	“
“	“	cork,	“	15	“
“	“	tallow,	“	59	“
“	“	oak,	“	73.15	“
“	“	brick,	“	125	“
“	“	air,	“	0.0753	“

## MEASURES OF CAPACITY.

Measure is length, breadth, and thickness, estimated by known lengths, or compared by other known quantities; thus, there are  $12 \times 12 \times 12 = 1,728$  cubic inches in a cubic foot, and  $3 \times 3 \times 3 = 27$  cubic feet in a cubic yard.

The imperial gallon is 277.274 cubic inches. A gill, or quarter of a pint, is  $8\frac{2}{3}$  inches.

The imperial gallon contains 10 lbs. avoirdupois, of dis-

tilled water, weighed in air at  $62^{\circ}$ , with the barometer at 30 inches. Two gallons are equal to a peck, eight to a bushel, and eight bushels to a quarter.

Heaped measure, per bushel, is  $2,815\frac{1}{4}$  cubic inches clear.

The Winchester bushel is  $18\frac{1}{2}$  inches in diameter, and 8 inches deep, containing  $2,154.42$  cubic inches.

1,000 ounces of rain-water are equal to about  $7\frac{1}{2}$  gallons wine measure, or to a cubic foot.

7 pounds avoirdupois is a gallon of flour.

A chaldron of coals is  $58\frac{2}{3}$  cubic feet.

Twelve wine gallons of distilled water, weigh 100 lbs. avoirdupois.

The imperial dry bushel, when not heaped, is  $2,218.192$  cubic inches; the peck,  $554.548$ ; gallon,  $277.274$ , and quart,  $69.3185$ . The bushel is 8 inches deep, and 18.8 wide, with a heap 6 inches high.

A bushel of wheat is 60 lbs., rye, 53 lbs., barley, 47 lbs., oats, 38, peas, 64, beans, 63, clover-seed, 68, rape, 48 lbs.

A Scotch pint is equal to four English pints.

A Scotch quart is  $208.6$  cubic inches.

There are  $545,267,000$  cubic yards in a cubic mile.

#### INTERESTING FACTS IN CHEMISTRY.

Chemistry is the study of the effects of heat and mixture, with the view of discovering their general and subordinate laws, and of improving the useful arts.—*Black.*

Whenever chemical action takes place, a real change is produced in the substance operated upon, and its identity is destroyed. If a little powdered chalk (carbonate of lime) be put into a glass of water, the chalk will sink to the bottom of the vessel. Though it should be mixed with the water, if left at rest it will soon subside; no chemical action has taken place; therefore the water and the carbonate of lime both remain unaltered. But if a small quantity of diluted sulphuric acid be added to a glass of chalk and water, a violent effervescence will commence the moment they come in contact with each other; a chemical union of the two substances will be the consequence of this chemical action; the identity of each substance will be destroyed, and sulphate of lime, or gypsum (a body very different from either of the substances employed) will be produced.

Heat has a tendency to separate the particles of all bodies from each other. Hence nothing more is necessary to effect the decomposition of many bodies than to apply heat, and collect the substances which are separated by that means.

It is evident that water exists in the atmosphere in abundance, even in the driest season, and under the clearest sky. There are substances which have the power of absorbing moisture from the air, at all times, such as the fixed alkalis, (potash and soda,) and sulphuric acid, the latter of which will soon absorb more than its own weight of water from the air, when exposed to it. Fresh-burnt lime absorbs it rapidly; and earth that has been freshly stirred absorbs it in a much greater degree, at night, than that which is crusted and compact. Hence the importance of stirring the soil among tillage crops, in time of drought.

Bishop Watson found, that even when there had been no rain for a considerable time, and the earth was dried by the parching heat of summer, it still gave out a considerable quantity of water. By inverting a large drinking-glass on a close-mown grass plat, and collecting the vapor which attached to the inside of the glass, he found that an acre of ground dispersed into the air about 1,600 gallons of water in the space of twelve hours, of a summer's day.

Lavoisier has explained solidity thus: "The particles of all bodies," says he, "may be considered as subject to the action of two opposite powers, repulsion and attraction, between which they remain in equilibrio. So long as the attractive force remains stronger, the body must continue in a state of *solidity*; but if, on the contrary, heat has so far removed these particles from each other as to place them beyond the sphere of attraction, they lose the cohesion they before had with each other, and the body ceases to be solid."

Aeriform substances (gases and vapors) are called *elastic*, because they are all capable of being reduced into a smaller compass by pressure, and of expanding again to their usual volume whenever the pressure is removed. Thus atmospheric air may be so compressed, that 128 volumes may be forced into a space usually occupied by *one* volume, and the greater the compression the more will its elasticity be increased. It is on this principle that the air-gun is constructed.—*Parke*

Fluidity is owing to the matter of heat being interposed between the particles of the fluid ; which heat would dissipate all fluids into the air, were it not for the pressure of the atmosphere, and the mutual attraction which subsists between those particles. Were it not for this atmospheric pressure, water would not be known in any other states than those of ice and vapor ; for, as soon as ice had acquired caloric enough to give it fluidity, it would evaporate, and be dispersed into the regions of space. This may be proved by direct experiment. The constitution of the world in this respect exhibits a beautiful instance of the harmony of Nature, and of the exquisite contrivance of its Divine Author.

On the other hand, could we totally abstract the matter of heat from any fluid, no doubt this fluid would by that means be changed to a solid, the lightest vapors being nothing more than solids combined with heat. Not only fluids, but all those substances which are soft and ductile, owe their properties to the chemical combination of caloric. Metals owe their malleability and ductility to the same cause ; for in very intense artificial cold, the most ductile metals, such as gold, silver, and lead, lose their malleability, and become brittle, as Van Mons has shown.—*Annals de Chimie.*

Take, for instance, mercury. This metal is a fluid body in our climate, but by cooling it to 30 degrees below the zero of Fahrenheit's thermometer, it becomes solid ; and if it be heated to 660 degrees, it will be volatilized and converted into vapor.

The elasticity of air and steam arises from the caloric being chemically combined with the solid substances of which they are composed. I say *solid*, because we have abundant evidence that oxygen and nitrogen [the principal elements of the atmosphere] are both capable of taking a solid form, and actually do, in many instances, exist in a state of solidity. Nitrogen is a component part of all animal substances, and exists in a solid state in all the ammoniacal salts. Oxygen takes the same state when it combines with metals and other combustibles ; and in the composition of the nitrous salts, they both take the same state of solidity. These facts surely evince that atmospheric air owes its fluidity to caloric.—*Parke.*

Whenever a body *changes* its state, it either combines with caloric, or separates from caloric.—*Dr. Black.*

It is an axiom in hydrostatics, that every substance which *swims* on water, displaces so much of the water as is exactly equal to its own weight ; whereas, when a substance *sinks* in water, it displaces water equal to its bulk. Take a piece of hard wood, balance it accurately in a pair of scales with water, and then place it gently in a vessel on the surface of water which will flow over the top of the vessel. If the wood be now taken out with care, it will be found that the water in the scale will exactly fill the vacancy left by the wood.—*It.*

The specific gravity of bodies is denoted in chemical writings by comparing it with the specific gravity of pure water, in decimal figures, water being always considered as 1.000. Thus the specific gravity of the strongest sulphuric acid (oil of vitriol) is 1.850, or nearly nine tenths heavier than water. Iron is 7.650, or more than  $7\frac{1}{2}$  times heavier than water ; that is, a cubic inch of iron, if put into a scale, would require  $7\frac{1}{2}$  inches of water to balance it ; silver is 10.470 ; gold 19.300 ; and platina 23.000, or 23 times heavier than water.

All substances that *float* upon water are specifically lighter than it, as oils, alcohol, &c. There are various instruments which, when dropped into liquids, indicate, upon a graduated scale, their specific gravity, be it heavier or lighter than water, as the areometer, hydrometer, &c. Thus the juice of the apple or grape is heavier than water in proportion to the quantity of sugar which it contains ; and after fermentation, it becomes specifically lighter than water in the same ratio, the sugar, which was heavier, being converted into alcohol, which is lighter than water. The tendency of wine or cider to run into the acetous or vinegar fermentation, is in proportion to its lightness before, and heaviness after fermentation—the lighter the must, the heavier the liquor, and the less sugar in the former, and less alcohol in the latter. The specific gravity of apple-juice varies from 1.000 to 1.091. Some we lately tried, from mixed fruit, indicated 1.063 by Baumè's areometer.—*Con.*

A pint measure of atmospheric air weighs nearly nine grains ; whereas a pint measure of hydrogen gas weighs little more than half a grain. The same measure of pure water weighs upwards of one pound avoirdupois.

It may be remarked, that the Creator has endowed atmospheric air with the property of preserving its own



equilibrium at all times, and in all places. Its elasticity is such, that, however it may be consumed by respiration or combustion, its place is immediately supplied with a new portion, and though, by a mistaken policy, the doors and windows of our habitations may be constructed so as to exclude it as much as possible, it will have admission ; it forces its way through every crevice, and performs the important office assigned it, in defiance of all exertions.—*Parke.*

## PHILOSOPHICAL FACTS.

The change of properties which takes place when chemical attraction acts, is not confined to metals, but is a general result in every case, where different bodies are brought into this state of combination or chemical union. Frequently we find that the properties of each body are totally changed ; and that substances, from being energetic and violent in their nature, become inert and harmless, and *vice versa*. For instance, that useful and agreeable substance, culinary salt, which is not only harmless, but wholesome, and absolutely necessary to the well-being of man, is composed of two formidable ingredients, either of which taken into the stomach proves fatal to life : one of these is a metal, and the other an air ; the former is called *sodium*, the latter *chlorine*. When presented to each other, the violence of their nature is manifested by their immediately bursting out into flame, and instantly they are both deprived of their virulence. Can any thing be more striking than the change of properties in this case ? and who could have supposed that culinary salt is composed of a metal united to an air ? The medicine called Glauber's salts is another instance ; it is composed of two caustic poisons of different kinds ; one called oil of vitriol, and the other barilla or soda. There are also two substances known to chemists, which are disgustingly bitter liquids ; one is called nitrate of silver, and the other hyposulphate of soda ; when mixed they form a compound of considerable sweetness. But the atmosphere which we breathe is the most extraordinary of all instances : it must be surprising to those who are unacquainted with the fact, that atmospheric air, indispensable as it is to life, is composed of the same ingredients as that most violent and destructive liquid called *aqua fortis*, or nitric acid. This powerful acid being made to

act upon sugar, the sweetest of all things, produces a substance intensely bitter to the taste. Charcoal is, of all known substances, the most difficult to convert into vapor; so much so, indeed, that the conversion has never yet been decidedly effected; it is also a very solid substance; and diamond, which is nothing but crystallized charcoal, is one of the hardest bodies in Nature. Sulphur, in the solid state, is also a hard substance, and to hold it in vapor requires a high temperature. But when these two substances, carbon and sulphur, are made to combine chemically so as to form the substance called bisulphuret of carbon, their properties are strikingly changed. Instead of the compound being hard, it is a thin liquid, and is not known to freeze or solidify at any degree of cold that can be produced. Instead of the compound being difficult to vaporize, it is, of all liquids, one of the most evaporable. Charcoal is the blackest substance with which we are acquainted—sulphur is of a most lively yellow hue; but the compound is as colorless as water. A new smell and taste are acquired, and, in a word, there is not one point of resemblance with the constituents. These facts are strikingly illustrative of the change of properties which follows on the exertion of chemical attraction between the ultimate particles of bodies.—*Donovan's Chemistry.*

When the marl contains, of carbonate of lime, per cent.	<i>Number of bushels of marl necessary to give one per cent. of carbonate of lime to an acre, for a ploughed depth of soil of</i>					
	3 inches.	4 inches.	5 inches.	6 inches.	7 inches.	8 inches.
10	875	1166	1458	1750	2041	2833
20	437	583	729	875	1020	1166
30	291	388	486	583	680	777
40	218	281	364	437	510	583
50	175	233	291	350	409	466
60	145	194	242	291	340	388
70	125	180	208	250	291	333
80	109	145	182	218	255	291
90	97	129	162	194	226	259
100	87	116	145	175	204	233

*Breadths and Lengths of an Acre, in rods or perches and feet.*

Breadth.		Length.		Breadth.		Length.	
Perches.	Perches.	Feet.	Perches.	Perches.	Feet.	Perches.	Feet.
10	16		28	5	$11\frac{11}{4}$		
11	14	9	29	5	$8\frac{11}{8}$		
12	13	$5\frac{1}{2}$	30	5	$5\frac{1}{2}$		
13	12	$5\frac{1}{3}$	31	5	$2\frac{5}{6}$		
14	11	$7\frac{1}{4}$	32	5			
15	10	11	33	4	14		
16	10		34	4	$11\frac{11}{7}$		
17	9	$6\frac{2}{3}$	35	4	$9\frac{2}{7}$		
18	8	$14\frac{2}{3}$	36	4	$7\frac{1}{3}$		
19	8	$6\frac{1}{5}$	37	4	$5\frac{1}{5}$		
20	8		38	4	$3\frac{9}{5}$		
21	7	$10\frac{3}{4}$	39	4	$1\frac{9}{3}$		
22	7	$4\frac{1}{2}$	40	4			
23	6	$15\frac{1}{3}$	41	3	$14\frac{7}{8}$		
24	6	11	42	3	$13\frac{5}{4}$		
25	6	$6\frac{3}{4}$	43	3	$11\frac{7}{6}$		
26	6	$2\frac{7}{5}$	44	3	$10\frac{1}{2}$		
27	5	$15\frac{5}{10}$	45	3	$9\frac{1}{6}$		

*Comparison of the American with the Scotch and Irish Acre.*

American.	Scotch.			Irish.		
Acres.	Acres.	Roods.	Perches.	Acres.	Roods.	Perches.
1	0	3	14.4	0	2	18.7
2	1	2	28.9	1	0	35.5
3	2	2	17.3	1	3	16.3
4	3	1	17.8	2	1	35.1
5	4	0	32.2	3	0	13.8
6	5	0	6.7	3	2	32.6
7	5	3	21.1	4	1	11.4
8	6	2	35.5	4	3	30.2
9	7	2	10	6	0	27.7
10	8	1	24.4	6	0	27.7
20	16	3	8.9	12	1	15.5
30	25	3	33.3	18	2	3.2
40	33	2	17.8	24	2	2.1

A TABLE, to show at a glance the number of hills or plants each other, from 40 feet by 40,

Feet.	Feet.	Per acre.	Feet.	Feet.	Per acre.	Ft. In.	Ft. In.	Per acre.
40	by 40	27	16	by 15	175	8 0	by 8 0	680
39	.. 39	28	16	.. 10	272	8 0	.. 7 0	777
38	.. 38	30	16	.. 5	544	8 0	.. 6 0	905
37	.. 37	31	15	.. 15	193	8 0	.. 5 0	1089
36	.. 36	33	15	.. 10	290	8 0	.. 4 0	1361
35	.. 35	35	15	.. 5	580	8 0	.. 3 0	1815
34	.. 34	37	14	.. 14	222	8 0	.. 2 0	2722
33	.. 33	40	14	.. 10	311	8 0	.. 1 0	5445
32	.. 32	42	14	.. 5	622	7 0	.. 7 0	888
31	.. 31	45	13	.. 13	257	7 0	.. 6 6	957
30	.. 30	48	13	.. 10	335	7 0	.. 6 0	1037
29	.. 29	51	13	.. 5	670	7 0	.. 5 6	1131
28	.. 28	55	12	.. 12	302	7 0	.. 5 0	1244
27	.. 27	59	12	.. 10	363	7 0	.. 4 6	1382
26	.. 26	64	12	.. 5	720	7 0	.. 4 0	1555
25	.. 25	69	11	.. 11	360	7 0	.. 3 6	1777
24	.. 24	75	11	.. 10	396	7 0	.. 3 0	2074
23	.. 23	82	11	.. 5	792	7 0	.. 2 6	2489
22	.. 22	90	10	.. 10	435	7 0	.. 2 0	3111
21	.. 21	98	10	.. 9	484	7 0	.. 1 6	4148
20	.. 20	108	10	.. 8	544	7 0	.. 1 0	6222
20	.. 15	145	10	.. 7	622	6 0	.. 6 0	1210
20	.. 10	217	10	.. 6	726	6 0	.. 5 6	1320
20	.. 5	435	10	.. 5	871	6 0	.. 5 0	1452
19	.. 19	120	10	.. 4	1089	6 0	.. 4 6	1613
19	.. 15	152	10	.. 3	1452	6 0	.. 4 0	1815
19	.. 10	229	10	.. 2	2178	6 0	.. 3 6	2074
19	.. 5	458	10	.. 1	4356	6 0	.. 3 0	2420
18	.. 18	134	9	.. 9	537	6 0	.. 2 6	2904
18	.. 15	161	9	.. 8	605	6 0	.. 2 0	3630
18	.. 10	242	9	.. 7	691	6 0	.. 1 6	4840
18	.. 5	484	9	.. 6	806	6 0	.. 1 0	7260
17	.. 17	150	9	.. 5	968	5 6	.. 5 6	1417
17	.. 15	170	9	.. 4	1210	5 6	.. 5 0	1584
17	.. 10	256	9	.. 3	1613	5 6	.. 4 6	1760
17	.. 5	512	9	.. 2	2420	5 6	.. 4 0	1980
16	.. 16	170	9	.. 1	4840	5 6	.. 3 6	2272

contained in an acre of land, at any given distance from to 1 foot by 1, omitting fractions.

Ft. In.	Ft. In.	Per acre.	Ft. In.	Ft. In.	Per acre.	Ft. In.	Ft. In.	Per acre.
5 6	by 3 0	2640	3 9	by 3 0	3872	3 0	by 1 0	14520
5 6	.. 2 6	3168	3 9	.. 2 9	4224	2 9	.. 2 9	5760
5 6	.. 2 0	3960	3 9	.. 2 6	4646	2 9	.. 2 6	6336
5 6	.. 1 6	5280	3 9	.. 2 3	5162	2 9	.. 2 3	7040
5 6	.. 1 0	7920	3 9	.. 2 0	5808	2 9	.. 2 0	7920
5 0	.. 5 0	1742	3 9	.. 1 9	6637	2 9	.. 1 9	9051
5 0	.. 4 6	1936	3 9	.. 1 6	7744	2 9	.. 1 6	10560
5 0	.. 4 0	2178	3 9	.. 1 3	9272	2 9	.. 1 3	12672
5 0	.. 3 6	2489	3 9	.. 1 0	11616	2 9	.. 1 0	15840
5 0	.. 3 0	2904	3 6	.. 3 6	3555	2 6	.. 2 6	6969
5 0	.. 2 6	3484	3 6	.. 3 3	3829	2 6	.. 2 3	7740
5 0	.. 2 0	4356	3 6	.. 3 0	4148	2 6	.. 2 0	8712
5 0	.. 1 6	5808	3 6	.. 2 9	4525	2 6	.. 1 9	9956
5 0	.. 1 0	8712	3 6	.. 2 6	4978	2 6	.. 1 6	11616
4 6	.. 4 6	2151	3 6	.. 2 3	5531	2 6	.. 1 3	13939
4 6	.. 4 0	2420	3 6	.. 2 0	6222	2 6	.. 1 0	17424
4 6	.. 3 6	2765	3 6	.. 1 9	7111	2 3	.. 2 3	8604
4 6	.. 3 0	3226	3 6	.. 1 6	8297	2 3	.. 2 0	9680
4 6	.. 2 6	3872	3 6	.. 1 3	9956	2 3	.. 1 9	11062
4 6	.. 2 0	4840	3 6	.. 1 0	12445	2 3	.. 1 6	12906
4 6	.. 1 6	6453	3 3	.. 3 3	4124	2 3	.. 1 3	15488
4 6	.. 1 0	9680	3 3	.. 3 0	4818	2 3	.. 1 0	19360
4 0	.. 4 0	2722	3 3	.. 2 9	4873	2 0	.. 2 0	10890
4 0	.. 3 9	2904	3 3	.. 2 6	5361	2 0	.. 1 9	12445
4 0	.. 3 6	3111	3 3	.. 2 3	5956	2 0	.. 1 6	14520
4 0	.. 3 3	3350	3 3	.. 2 0	6701	2 0	.. 1 3	17424
4 0	.. 3 0	3630	3 3	.. 1 9	7658	2 0	.. 1 0	21780
4 0	.. 2 9	3960	3 3	.. 1 6	8935	1 9	.. 1 9	14223
4 0	.. 2 6	4356	3 3	.. 1 3	10722	1 9	.. 1 6	16594
4 0	.. 2 3	4840	3 3	.. 1 0	13403	1 9	.. 1 3	19913
4 0	.. 2 0	5445	3 0	.. 3 0	4840	1 9	.. 1 0	24454
4 0	.. 1 9	6222	3 0	.. 2 9	5289	1 6	.. 1 6	19360
4 0	.. 1 6	7260	3 0	.. 2 6	5808	1 6	.. 1 3	23232
4 0	.. 1 3	8712	3 0	.. 2 3	6453	1 6	.. 1 0	29040
4 0	.. 1 0	10890	3 0	.. 2 0	7260	1 3	.. 1 3	27878
3 9	.. 3 9	3097	3 0	.. 1 9	8297	1 3	.. 1 0	34848
3 9	.. 3 6	3318	3 0	.. 1 6	9680	1 0	.. 1 0	43560
3 9	.. 3 3	3574	3 0	.. 1 3	11616			

## AN ACRE OF LAND CONTAINS

- 4 Roods, each rood 40 rods, poles, or perches.  
 160 Rods,  $30\frac{1}{4}$  yards each.  
 4,840 Square yards, 9 feet each.  
 43,560 Square feet, 144 inches each.  
 174,240 Squares of 6 inches each.  
 6,272,640 Inches, or squares of one inch each.

*A Table of various Foreign Coins, &c., with their value in Federal Money, as established by an act of Congress.*

	\$	d.	c.	m.
Pound sterling, .....	4	8	7	5
Pound of Ireland, .....	4	1	0	0
Pound of the Canadas, .....	4	0	0	0
Pagoda of India, .....	1	9	4	0
Mill-rea of Portugal, .....	1	2	4	0
Rouble of Russia, .....	0	6	6	0
Rupce of Bengal, .....	0	5	5	0
Guilder of the Netherlands, .....	0	3	9	0
Mark Banco of Hamburg, .....	0	3	4	4
Livre of France, .....	0	1	8	5
Real of Spain, .....	0	1	0	0

*A Table of the weight and value of certain Foreign Coins.*

Names.	Standard weight.		Federal value.				
	dwt.	gr.	E.	\$	d.	c.	m.
<i>Gold.</i>							
A Johannes, .....	18	0	1	7	0	6	4
A Half Johannes, .....	9	0	0	8	5	3	2
A Doubloon, .....	17	9	1	5	5	3	5
An English Guinea, .....	5	$9\frac{1}{2}$	0	5	7	7	5
<i>Silver.</i>							
English or French Crown,	19	0	0	1	1	0	0
The Dollar of Spain, Sweden, or Denmark, .....	17	6	0	1	0	0	0
An English Shilling, .....	3	11	0	0	2	2	2

# DEFINITIONS

## OF TERMS USED IN AGRICULTURE.

- Aeriform*, having the form and nature of an elastic invisible fluid, like air.
- Agriculture*, the cultivation and management of the soil, on the scale of a farm, by animal and manual labor and steam-power, for the production of materials useful for the food and service of man, and for various purposes in arts, manufactures, and civilized life.
- Aliment*, that which nourishes animals or vegetables; the nutritive quality of food, dissolved and blended with the juices of the stomach, or the moisture of the soil, and converted into chyle or sap, by the digestive process, and taken up by the lacteals or spongioles, (chyle or sap carrying vessels.)
- Alkaline Earths*, so called from their possessing most of the qualities of alkalies, as lime, magnesia, strontia, baryta.
- Alluvial Soils*, formed by the action of water, as river flats, composed of various and heterogeneous materials.
- Anbury*, a disease of turnips and cabbages—tumors upon the roots, caused by insects.
- Animalcule*, in its general acceptation, a little animal, but since the invention of the microscope, the term is particularly applied to the myriads of insects, too small to be seen by the naked eye, which are discovered by that instrument.
- Animal Manures*, all dead animal matters, as fish, bone, horn. *Vegeto-animal Manures*, stable and yard dung, partaking of vegetable and animal matters.
- Annual Plants*, such as flower, seed, and die, the year they are grown.
- Antiseptic*, a term applied to those substances which check or resist putrefaction, as salt, &c.
- Aquatic Plants*, plants growing in water.
- Arable Husbandry*, where the raising of grain is the main object of the cultivator, as in wheat-growing districts.
- Arborculture*, or planting, is the cultivation of useful trees and shrubs, and is another term for rural embellishment.
- Assimilation*, in animal and vegetable economy, is that hidden, natural process by which living animals and plants are enabled to convert such bodies as have a certain affinity for them, or at least after having undergone some preparation, and change of properties, into their own substance and nature.
- Biennial Plants*, such as flower and seed the second year and then die, as the carrot, cabbage, onion.

- Brairding well*, a Scotch term, denoting, in young grain, a foliage which promises an abundant product.
- Calcareous Soils*, such as will effervesce with acids. According to Sir Humphrey Davy, they contain at least seven eighths of sand.
- Cereal Grasses*, those raised for bread-corn; wheat, &c.
- Clayey Soils*. This term, Sir Humphrey Davy says, should not be applied to soils which contain less than one sixth of impalpable matter. They are called *argillaceous*, and often *aluminous* soils.
- Composts*, mixtures of various earthy and vegetable materials, as peat earth, lime, dung, loam, &c.
- Convertible Husbandry*, mixed husbandry, which implies frequent change, in the same field, from tillage to grass, and from grass to tillage—an alternation of dry, root, and grass crops.
- Corn*, in Europe, embraces every crop that is convertible into bread, as wheat, barley, oats, &c. In the United States, the term is particularly applied to maize, or Indian corn.
- Cotyledons*, seed-lobes, or seed-leaves, the fleshy parts of seeds, or the two halves, which separate in the act of sprouting, and rise above the ground.
- Cropping*, the raising, cutting, and carrying off the crop; generally applied to tillage crops.
- Culinary Vegetables*, such as are raised for the table.
- Culmiferous Crops*, consist of the grains and the grasses which have smooth, jointed stalks, (culms,) and seed contained in chaffy husks, as wheat, timothy, &c. These have generally fibrous roots.
- Dry Crops*, are those which mature their seeds before they are gathered, as wheat, rye, barley, &c. They are considered the most exhausting crops.
- Earth*, as applied to the ground, lime, clay, sand, or one or more earthy materials, in a friable and divided state, and either alone or mixed, but without the addition of much organic matter.
- Farmer*, one who cultivates a farm, be he proprietor or tenant. On the old continent, the term is only applied to such as pay rent. As our cultivators are generally proprietors, we give to the term its broadest, though perhaps not its legitimate definition.
- Ferruginous Soils*, are those which abound in iron, the presence of which is generally indicated by a red or yellow color, in the soil and the waters which pass through it.
- Floriculture*, is that branch of gardening, which has cognizance of flowers, of ornamental shrubs, and forcing and exotic gardening, so far as respects plants of ornament.
- Foliage Grasses*, plants cultivated for their leaves, to be used green, as the cabbage, spinach, lettuce tribes, &c.
- Furrow Drains*, parallel drains, made at intervals of sixteen to thirty feet, generally in the furrows between ridges, on flat and retentive soils, constructed like under drains.
- Geine*, of like import with *Humus*, which see.
- Germination*, the act of sprouting; the beginning of vegetation in a seed or plant.
- Grass Crops*, are the grasses cut for hay, or fed off in pasturage.



*Grass Husbandry*, where the principal object is the dairy, the rearing of domestic animals, &c., as in grazing districts.

*Green Crops*, are clover, buckwheat, or other growing crops, buried by the plough to enrich the soil—considered improving crops.

*Herbage Plants*, clover and other plants cultivated chiefly for the herb, to be used either green or to be made into hay.

*Horticulture*, is to the garden, what agriculture is to the farm,—the application of labor and science to a limited spot, for convenience, for profit, or for ornament—though implying a higher state of cultivation than is common in agriculture. It includes the cultivation of culinary vegetables and of fruits, and forcing or exotic gardening, as far as respects useful products.

*Humus*, or *Geine*, the product of organic matter, and the food of plants.

*Husbandman*, one who farms generally; that is, who produces both grain and cattle, and attends to the dairy, the poultry, and the orchard. A farmer, says Loudon, may confine himself to grazing, or to breeding, or to haymaking, or milking, or raising green crops for the market, &c., but in none of these cases can he with propriety be called a husbandman. The term farmer is therefore not exactly synonymous with husbandman.

*Husbandry*, is here used as comprehending all that belongs to agriculture.

*Inorganic Matter*, devoid of organs; not formed with the organs or instruments of life; pure earths.

*Insoluble Matters*, matters which cannot be dissolved by the waters of the soil.

*Landscape Gardening*, is the art of so arranging the external scenes of a country residence, as to render them ornamental, both as domestic scenery, and as a part of the general scenery of a country.

*Latter mow*, *After mow*, *Rowen*, are all terms which express the second crop of grass.

*Lay*, *Ley*, *Lea*, different terms applied to meadow, pasture, or sward.

*Leguminous Crops*—peas, beans, and the like—having a seed-vessel with two valves, in which the seeds are fixed to one side only.

*Liquid Manures*, those that are applied in a liquid form, as urine, the liquids of the cattle-yard, soap-suds, &c.

*Manures*, every species of matter capable of promoting the growth of vegetables. See *Animal*, *Mineral*, and *Vegetable*.

*Mechanical Manures*, are those which serve to improve the texture of soils, as sand applied to clay, clay to sand, and marl or mild lime to both, when they are deficient in calcareous matter.

*Mineral Manures*, such as serve to dissolve the organic matters in the soil, to induce new soluble compounds, or to stimulate the organs of plants, as quicklime, gypsum, ashes, salt, &c.

*Mould*, organic matter in a finely divided and decomposed state, with a little admixture of earth, as vegetable mould, leaf mould, peat mould, &c.

*Organic Matters*, animal or vegetable matters in a greater or less state of decay.

*Organic Remains*, are the remains of living bodies either petrified or imbedded in stone.

*Peaty Soils*, are those of morasses, swamps, &c., and to be entitled to this application, should consist, according to Sir Humphrey Davy, of one half vegetable matter.

*Perennial Plants*, those that do not generally flower the first year, but die down to the ground, and grow up again the next spring, and so on for a number of years, as rhubarb, horse-radish, &c.

*Primitive Soils*, such as exist in primitive or early formations of the globe, destitute of organic remains, as most of those of New England.

*Professional Gardener*, one who has served an apprenticeship to gardening, and understands the processes of culture, propagation, and forcing.

*Root Crops*, are potatoes, turnips, beets, carrots, &c., which divide and pulverize the soil by their roots, and keep it clean from weeds. These are called ameliorating crops.

*Saline Soils*, are those which become impregnated with marine or common salt, by being flooded with sea-water, or from other causes.

*Sandy Soils*, are those which contain, according to Sir Humphrey Davy, at least seven eighths of sand. These are denominated *silicious* soils.

*Secondary Soils*, belong to secondary or more recent formations, and abound more or less in organic remains.

*Soil*, earth either of one or of several sorts, mixed with decomposed organic matter.

*Soils*, see *Alluvial*, *Calcareous*, *Clayey*, *Ferruginous*, *Peaty*, *Primitive*, *Saline*, *Sandy*, *Secondary*.

*Soluble Matters*, organic matters which can be dissolved by the waters of the soil.

*Stolons*, roots that produce suckers or fruits; as of the potato, which produce tubers, or of the quack or June grasses, which send up shoots or suckers.

*Strata*, the plural of *stratum*, beds or layers of earth or other substances.

*Stratum*, a bed, or layer, naturally or artificially formed, distinct from the adjacent matter.

*Under Drains*, drains for the conveyance of water, made of stone, tile, or other materials, and covered with earth.

*Vegetables*, plants, organized bodies, generally deriving their nourishment from the soil.

*Vegetable Manures*, vegetable matters which have not undergone the process of animal mastication, as green crops, straw, &c.

*Vegeto-animal Manures*, see *Animal Manures*.

# A GLOSSARY

## OF CHEMICAL TERMS.

- Absorption*, the conversion of a gaseous fluid into a liquid or solid.
- Acetate*, salt formed by the combination of any base with the acetic acid.
- Acetate of lead*, sugar of lead.
- Acetic acid*, concentrated vinegar.
- Acids*, compounds of bases with oxygen, hydrogen, &c.
- Æther*, a volatile liquid, formed of alcohol and an acid.
- Affinity*, a force by which substances of *different* kinds unite.
- Alkali*, (*fossil*, or *mineral*,) soda.
- Alkali*, (*vegetable*,) potash.
- Alkali*, (*volatile*,) ammonia.
- Alcohol*, rectified spirits of wine.
- Alluvial*, depositions of soil made by water.
- Alum*, a compound of sulphuric acid, alumine, and potash, or ammonia.
- Alumine*, earth of alum ; pure argillaceous clay.
- Anthracite*, mineral coal containing no bitumen.
- Areometer*, a graduated glass instrument with a bulb, by which the specific gravity of liquids is taken ; an hydrometer.
- Argillaceous*, of the nature of clay.
- Aroma*, the odor which arises from certain vegetables, or their infusions.
- Azote*, nitrogen ; the basis of atmospheric air, of ammonia, nitrous acid, &c.
- Barometer*, an instrument which shows the variation of atmospheric pressure.
- Bell metal*, an alloy of tin and copper.
- Brass*, an alloy of copper and zinc.
- Calcareous*, partaking of the nature of lime.
- Caloric*, the chemical term for the matter of heat.
- Caloric*, (*free*,) radiant heat, or that which is not in chemical union with other bodies.
- Caloric*, (*latent*,) the matter of heat in a state of combination ; not perceptible.
- Carbon*, the base of diamond and of charcoal.
- Carbonate of lime*, the compound of carbonic acid and lime, under the names of marble, limestone, calcareous spar, chalk, &c.
- Carbonate of potash*, common potash ; pearlsh ; salt of tartar.
- Carbonic acid*, carbon combined with oxygen.
- Chalybeate*, the term applied to mineral waters impregnated with iron.
- Citric acid*, the acid of lemons.

- Cohesion*, a force inherent in all the particles of bodies, by which they are prevented from falling to pieces.
- Concentration*, the act of increasing the specific gravity of bodies.
- Decomposition*, separation of the constituent principles of compound bodies.
- Effervescence*, an intense motion which takes place in certain bodies caused by the escape of a gaseous substance.
- Efflorescence*, the pulverulent form of saline bodies produced by exposure to the air, in consequence of losing their water of crystallization.
- Elements*, are, properly, the simple constituent parts of bodies, incapable of decomposition, or further division.
- Essences*, the essential oils obtained by distillation from odoriferous vegetable substances.
- Evaporation*, dissipation of fluids by heat; evaporating fluids into vapor by heat.
- Fermentation*, a peculiar spontaneous motion, which occurs in vegetable substances, if exposed to proper temperature, under certain circumstances. It is usually divided into the acetous, vinous, saccharine, and putrefactive stages.
- Fluidity*, a term applied to all liquid substances. Solids are converted into fluids by combining with a certain portion of caloric.
- Gallic acid*, the acid found in gall-nuts.
- Gas*. All solid substances, when converted into permanently elastic fluids by caloric, are called gases.
- Gelatin*, a chemical term for animal jelly.
- Gluten*, a vegetable substance allied to gelatin.
- Gravity*, that property by which bodies fall to the earth.
- Gravity*, (*specific*,) is the weight of any solid or fluid body, compared with the *same measure* of distilled water.
- Hydrates*. Those substances which have formed so intimate an union with water as to solidify the water, and render it one of its component parts, are called hydrates.
- Hydrate of lime*, lime slaked in water.
- Hydrogen*, the base of water; inflammable air.
- Hydrometer*, see *Areometer*.
- Incineration*, the converting of vegetables to ashes, by burning.
- Laboratory*, a room fitted up with apparatus for the performance of chemical operations.
- Lime*, quicklime; calcareous earth; oxide of calcium.
- Lute*, a composition for closing the junctures of chemical vessels, &c.
- Maceration*, softening a solid body in a fluid, without impregnating the fluid with it.
- Malic acid*, acid of apples.
- Malleability*, that property of metals which gives them the quality of being extended and flattened by hammering.
- Menstruum*, the fluid in which a *solid* body is dissolved.
- Mineral*, any natural substance of a metallic, earthy, or saline nature.
- Mordants*, substances which have a chemical affinity for particular colors, as alum.
- Mucilage*, a vegetable principle allied to gum.
- Muriates*, salts formed by the combination of any base with muriatic acid.

*Muriatic acid*, spirit of sea-salt.

*Muriate of soda*, common salt.

*Nitrate of potash*, saltpetre, nitre.

*Nitrates*, salts formed by the combination of any base with nitric acid.

*Neutral salt*, a substance formed by the union of an acid with an alkali, an earth, or a metallic oxide, in such proportions as to saturate both the base and the acid.

*Oxalic acid*, the acid found in sorrel.

*Oxide*, any substance combined with oxygen, in a proportion not sufficient to produce acidity; rust of metals.

*Oxidize*, to combine oxygen with a body without producing acidity.

*Oxygen*, a simple substance, being one of the component parts of water and of atmospheric air; vital air.

*Oxygen gas*, oxygen converted into gas by combining with caloric.

*Pellicle*, a thin skin which forms on the surface of saline and other liquids, when boiled down to a certain strength.

*Pyrolignic acid*, an acid obtained from wood by burning.

*Sal*, a salt.

*Saturation*, the act of impregnating a fluid with another substance, till no more of it can be received or imbibed.

*Silicious earths*, natural substances which are composed chiefly of silica; as quartz, flint, sand, &c.

*Simple substances*, synonymous with elements; not divisible.

*Smelting*, the operation of fusing ores, to separate the metal from the sulphur, arsenic, and other matters with which it is combined.

*Solution*, the perfect union of a solid substance with a fluid.

*Sulphates*, *Sulphats*, *Sulphites*, salts formed by the combination of any base with sulphuric acid.

*Sulphate of copper*, blue vitriol; blue stone.

*Sulphate of iron*, copperas; green vitriol.

*Sulphate of lime*, gypsum.

*Sulphate of soda*, Glauber's salts.

*Sulphate of zinc*, white vitriol.

*Sulphate of potash*, a chemical salt, composed of sulphuric acid and potash. *Sulphuret of potash*, sulphur and potash fused together.

*Sulphate of magnesia*, Epsom salts.

*Sulphuric acid*, oil of vitriol; vitriolic acid.

*Super-tartrate of potash*, cream of tartar.

*Subacetate of copper*, verdigris.

*Sulphurets*, combinations of alkaline earths or metals with sulphur.

*Tartaric acid*, the acid found in the grape.

*Tartrates*, *Tartrites*, salts formed by the combination of any base with the acid of tartar.

*Thermometer*, an instrument to show the relative heat of bodies and of the atmosphere.

*Trituration*, the pulverizing, or uniting of bodies by friction.

*Torrefaction*, roasting of ores.

*Vacuum*, a space unoccupied by matter.



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## VOL. I.—WINTER.

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Arts of the Egyptians, Assyrians, Jews, Hindoos, Chinese, Greeks, Romans, Dark Ages, Modern Times, Nineteenth Century.

#### CHAPTER II.

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## CHAPTER XXII.

## Arts of Induration by Heat.

Bricks, Tiles, Terra Cotta, Crucibles, Pottery, Operations, Stone Ware, White Ware, Throwing, Pressing, Casting, Burning, Printing, Glazing, China Ware, European Porcelain, Etruscan Vases.

A FAMILIAR TREATISE ON THE CONSTITUTION OF THE UNITED STATES, by the Hon. JUDGE STORY, L. L. D., *Author of 'Commentaries on the Constitution,' &c.*

## LIFE OF DR. FRANKLIN.

SELECTIONS FROM THE WRITINGS OF FRANKLIN, by JARED SPARKS, L. L. D., *Professor of History in Harvard University, Author of 'the Life and Writings of Washington,' 'the Life and Writings of Franklin,' &c. &c.*

CHRISTIANITY AND KNOWLEDGE, by the Rev. ROYAL ROBBINS.

The design of this Work is to show what Christianity has done for the human intellect, and what that has done for Christianity.

THE LORD OF THE SOIL, OR, PICTURES OF AGRICULTURAL LIFE ; by Rev. WARREN BURTON, *Author of 'The District School as it Was,' &c. &c.*

SCIENCE AND THE ARTS, by the Rev. ALONZO POTTER, D. D., *Professor of Moral Philosophy and Rhetoric, in Union College, Schenectady, N. Y.*

The design of this Work is to call attention to the fact that the Arts are the result of *intelligence*—that they have, each one its *principles* or *theory*—that these principles are furnished by *Science*, and that he, therefore, who would understand the Arts, must know something of Science ; while, on the other hand, he who would see the true power and worth of Science ought to study it in its applications. The work will be made up of *facts*, illustrating and enforcing these views—so arranged as to exhibit the invariable connexion between *processes* in *Art*, and *laws* in *Nature*. The importance of such a work requires no comment.

AGRICULTURE, by the Hon. JUDGE BUEL, of Albany, *Editor of 'the Cultivator.'*

This Work is intended as an aid to the *Young Farmer*, and from the known character of the gentleman who has it in hand, there can be no doubt but that it will be executed in a highly satisfactory manner. The following, among other subjects, will be therein treated of, viz.

1. The Importance of Agriculture to a Nation.
2. Improvement in our Agriculture practicable and necessary.
3. Some of the principles of the new and improved Husbandry.
4. Agriculture considered as an Employment.
5. Earths and Soils.
6. Improvement of the Soil.
7. Analogy between Animal and Vegetable Nutrition.
8. Further Improvement of the Soil.
9. " " by Manures, Animal and Vegetable.
10. " " by Mineral Manures.
11. Principles and Operations of Draining.
12. Principles of Tillage.
13. Operations of Tillage, &c. &c.

Due notice will also be taken of alternating crops, root husbandry, mixed husbandry, the management of pasture and meadow lands, the garden, orchard, &c.

Cuts, illustrative of the various operations spoken of and recommended, will be given.

GEOLOGY AND MINERALOGY, by CHARLES T. JACKSON, M. D., *Geological Surveyor of Maine and Rhode Island.*

STATISTICS OF THE UNITED STATES, by GEORGE TUCKER, *Professor of Moral Philosophy in the University of Virginia, Author of 'the Life of Jefferson,' &c. &c.*

AMERICAN TREES AND PLANTS, used for medicinal and economical purposes and employed in the Arts, with numerous engravings ; by Professor JACOB BIGELOW, *Author of 'Plants of Boston,' 'Medical Botany,' &c. &c.*

MORAL EFFECTS OF INTERNAL IMPROVEMENTS, by ROBERT RANTOUL, Jr., Esq.

LIVES OF THE REFORMERS, by Rev. ROMEO ELTON, *Professor of Languages in Brown University.*

BIOGRAPHICAL SKETCHES OF DISTINGUISHED FEMALES, by Mrs. EMMA C. EMBURY, of *Brooklyn, N. Y.*

SKETCHES OF AMERICAN CHARACTER, by Mrs. SARAH J. HALE, *Editor of 'the Ladies' Book,' Author of the 'Ladies' Wreath,' 'Flora's Interpreter,' &c. &c.*

DO RIGHT AND HAVE RIGHT, by Mrs. ALMIRA H. LINCOLN PHELPS, *Principal of the Literary Department of the Young Ladies' Seminary, at West Chester, Pa., formerly of the Troy Seminary, N. Y., Author of 'Familiar Lectures on Botany,' 'Female Student,' &c.*

The object of this Work may be gathered from the following remarks of Mrs. Phelps. "A popular work on the principles of law, with stories illustrating these principles, might be very profitable to people in common life, as well as to children. The ward cheated by a guardian, the *widow* imposed on by administrators or executors, the *wife* abandoned by a husband, with whom she had trusted her paternal inheritance, the *partner* in business, overreached by his crafty associate, for want of a knowledge of the operations of the law,—all these might be exhibited in such a way as to teach the necessity of legal knowledge to both sexes, and to all ages and classes."

SCENES IN THE LIFE OF JOANNA OF SICILY, by Mrs. E. F. ELLET, of *Columbia, S. C.*

This is written with a view to young readers, and for the purpose of illustrating important historical events.

The Publishers have also in preparation for this Series, a History of the United States, and of other Countries, a History of the Aborigines of our Country, a History of Inventions, Works on Botany, Natural History, &c. &c. Many distinguished writers, not here mentioned, have been engaged, whose names will be in due time announced, although at present, we do not feel at liberty to make them public.

Among the works prepared, and in a state of forwardness, for the *Juvenile Series* are the following, viz.

MEANS AND ENDS, OR SELF TRAINING, by Miss CAROLINE SEDGWICK, *Author of 'The Poor Rich Man, and Rich Poor Man,' 'Live and Let Live,' 'Home,' &c. &c.*

NEW-ENGLAND HISTORICAL SKETCHES, by N. HAWTHORNE, *Author of 'Twice Told Tales,' &c.*

CONVERSATIONS AND STORIES BY THE FIRE SIDE, by Mrs. SARAH J. HALE,

FAILURE NOT RUIN, by HORATIO G. HALE, A. M.

TALES IN PROSE, blending instruction with amusement; by Miss MARY E. LEE, of *Charleston, S. C.*

PICTURES OF EARLY LIFE :—Stories; each inculcating some moral lesson; by Mrs. EMMA C. EMBURY, of *Brooklyn, N. Y.*

FREDERICK HASKELL'S VOYAGE ROUND THE WORLD, by H. G. HALE, A. M., *Philologist to the Exploring Expedition.*

BIOGRAPHY FOR THE YOUNG, by Miss E. ROBINS, *Author of 'American Popular Lessons,' Sequel to the same, &c.*

THE WONDERS OF NATURE, by A. J. STANSBURY, Esq., of *Washington City*; illustrated by numerous cuts.

WORKS OF ART, by the same; illustrated by numerous cuts.

PLEASURES OF TASTE, AND OTHER STORIES selected from the Writings of JANE TAYLOR, with a sketch of her life, (and a likeness,) by Mrs. S. J. HALE.

SELECTIONS FROM THE WORKS OF MRS. BARBAULD, with a *Life and Portrait.*

SELECTIONS FROM THE WORKS OF MARIA EDGEWORTH, with a *Life and Portrait.*

SELECTIONS FROM THE WORKS OF MRS. SHERWOOD, with a *Life and Portrait.*

SELECTIONS FROM THE WORKS OF DR. AIKIN, with a *Sketch of his Life,* by Mrs. HALE.

CHEMISTRY FOR BEGINNERS, by BENJAMIN SILLIMAN, Jr., *Assistant in the Department of Chemistry, Mineralogy, and Geology in Yale College*; aided by Professor SILLIMAN.

MY SCHOOLS AND MY TEACHERS, by Mrs. A. H. LINCOLN PHELPS.

The author's design, in this work, is to describe the Common Schools as they were in New-England at the beginning of the present century ; to delineate the peculiar characters of different Teachers ; and to give a sketch of her various school companions, with their progress in after life, endeavoring thereby to show that the child, while at school, is forming the future man, or woman.

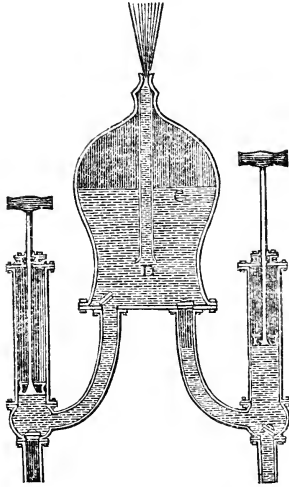
It is not the intention of the Publishers to drive these works through the Press with a railroad speed, in the hope of securing the market, by the multiplicity of the publications cast upon the community ; they rely for patronage, upon the intrinsic merits of the works, and consequently time must be allowed the writers to mature and systematize them. The more surely to admit of this, the two Series will be issued in sets of five and ten volumes at a time. Besides the advantage above alluded to, that will result from such an arrangement, it will place THE SCHOOL LIBRARY within the reach of those Districts, which, from the limited amount of their annual funds, would not otherwise be enabled to procure it.

The works will be printed on paper and with type expressly manufactured for the Library ; will be bound in cloth, with leather backs and corners, having gilt titles upon the backs, and for greater durability, cloth hinges inside of the covers.

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The Publishers solicit orders from School Committees, Trustees, Teachers, and others, for either or both Series, and wish particular directions *how*, to *whom*, and to *what place* the books shall be forwarded.

Annexed are Specimen Pages of the two Series.

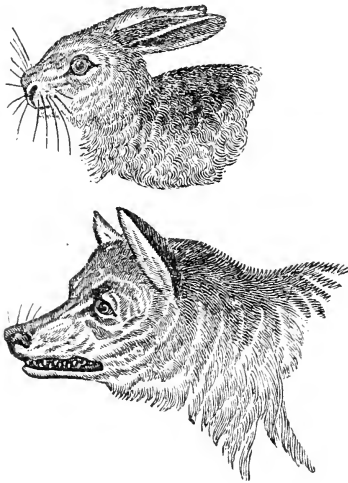


carried into the reservoir, and they fill it half full of water, C ; the mouth of the pipe, D, which is to convey away the water, reaches into the water in the reservoir. As the water rises, the air is compressed : so that, although the pumps act alternately, the elasticity of the contained air acts uninterruptedly in pressing on the surface of the water, and raising it by the tube, D, in an equable stream. The elasticity of the contained air, fills up the interval between the actions of the pumps, and admits of no interruption to the force with which the water is propelled upwards.

Surely these are sufficient indications of the necessity of three powers acting in propelling the blood from the heart. The first, is a sudden and powerful action of the ventricle : the second, is a contraction of the artery, somewhat similar, excited by its distention : the third, though a property independent of life, is a power permitting no interval or alternation ; it is the elasticity of the coats of the artery : and these three powers, duly adjusted, keep up a continued stream in the blood-vessels. It is true, that when an artery is wounded, the blood flows

The superior sagacity of animals which hunt their prey, and which, consequently, depend for their livelihood upon their *nose*, is well known in its use; but not at all known in the organization which produces it.

The external *ears* of beasts of prey, of lions, tigers, wolves, have their trumpet-part, or concavity, standing forward, to seize the sounds which are before them—viz., the sounds of the animals which they pursue or watch. The ears of animals of flight are turned backward, to give notice of the approach of their enemy from behind, whence he may steal upon them unseen. This is a critical distinction, and is mechanical; but it may be suggested, and, I think, not without probability, that it is the effect of continual habit.



[Heads of the hare and wolf, showing the different manner in which the ears are turned.—AM. ED.]

The *eyes* of animals which follow their prey by night, as cats, owls, &c., possess a faculty not given to those of other species, namely, of closing the pupil *entirely*.



It is difficult even for the imagination to conceive the feelings of such a man, at the moment of so sublime a discovery. What a bewildering crowd of conjectures must have thronged upon his mind, as to the land which lay before him, covered with darkness. That it was fruitful was evident from the vegetables which floated from its shores. He thought, too, that he perceived in the balmy air the fragrance of aromatic groves. The moving light which he had beheld, proved that it was the residence of man. But what were its inhabitants? Were they like those of other parts of the globe; or were they some strange and monstrous race, such as the imagination in those times was prone to give to all remote and unknown regions? Had he come upon some wild island, far in the Indian seas; or was this the famed Cipango itself, the object of his golden fancies? A thousand speculations of the kind must have swarmed upon him, as he watched for the night to pass away; wondering whether the morning light would reveal a savage wilderness, or dawn upon spicy groves, and glittering fanes, and gilded cities, and all the splendors of oriental civilization.

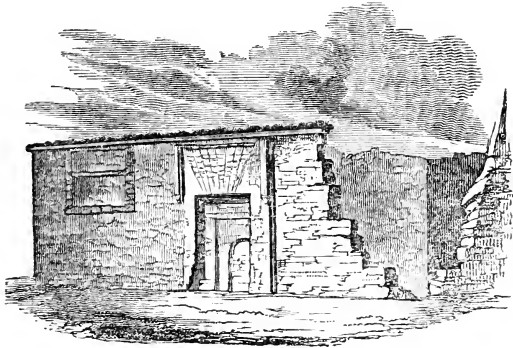
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## CHAPTER XI.

*First Landing of Columbus in the New World.—Cruise among the Bahama Islands.—Discovery of Cuba and Hispaniola. [1492.]*

WHEN the day dawned, Columbus saw before him a level and beautiful island, several leagues in extent, of great freshness and verdure, and covered with trees like a continual orchard. Though every thing appeared in the wild luxuriance of untamed nature, yet the island was evidently populous, for the inhabitants were seen issuing from the woods, and running from all parts to the shore. They were all perfectly naked, and from their attitudes

residence of Martin Alonzo or Vicente Yañez Pinzon, in the time of Columbus.



We now arrived at the church of St. George, in the porch of which Columbus first proclaimed to the inhabitants of Palos the order of the sovereigns, that they should furnish him with ships for his great voyage of discovery. This edifice has lately been thoroughly repaired, and, being of solid mason-work, promises to stand for ages, a monument of the discoverers. It stands outside of the village, on the brow of a hill, looking along a little valley toward the river. The remains of a Moorish arch prove it to have been a mosque in former times; just above it, on the crest of the hill, is the ruin of a Moorish castle.

I paused in the porch, and endeavored to recall the interesting scene that had taken place there, when Columbus, accompanied by the zealous friar Juan Perez, caused the public notary to read the royal order in presence of the astonished alcaldes, regidores, and alguazils; but it is difficult to conceive the consternation that must have been struck into so remote a little community, by this sudden apparition of an entire stranger among them, bearing a command that they should put their persons and ships at his disposal, and sail with him away into the unknown wilderness of the ocean.

The interior of the church has nothing remarkable,

work of creation and the work of grace revealed in the word of God. Proofs corroborative of the authenticity of the Bible, have been gathered from those very sources which formerly were applied to by the skeptic for his sharpest weapons ; and at this moment, (such is the security with which Christianity may regard the progress of knowledge,) there does not exist in our own country, nor, so far as I am aware, in any other, one philosopher of eminence who has ventured to confront Christianity and philosophy, as manifestly contradictory. May we not venture to hope that, in a very short time, the weak darts of minor spirits, which from time to time are still permitted to assail our bulwarks, will be also quenched, and the glorious Gospel, set free from all the oppositions of science falsely so called, shall walk hand in hand over the earth with a philosophy always growing in humility, because every day becoming more genuine. C. J. C. D.

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## TWELFTH WEEK—MONDAY.

### VEGETABLE SUBSTANCES USED FOR WEAVING.—THE COTTON-PLANT.

THE cotton-plant, another vegetable substance, extensively used in manufactures, differs materially from that already described, in its properties, appearance, and habits. Instead of being generally diffused over temperate climates, it belongs more properly to the torrid zone, and the regions bordering on it ; and instead of being chiefly confined to one species, as to its peculiar and useful qualities, its varieties seem scarcely to have any limit, extending from an herb\* of a foot or two in height, to a tree†

\* *Gossypium herbaceum*, or common herbaceous cotton-plant.

† *Bombax ceiba*, or American silk cotton-tree.—[The Baobab, or *Adansonia digitata*, an enormous and long-lived tree, also belongs to this family. But it is incorrect to call these trees “ varieties ” of the cotton plant. They are nearly allied to it, indeed, but they stand in different divisions of the great order of *malvacee*, or mallows ; and the downy contents of their pods are of little use compared with true cotton.—AM. ED.]

*Coup de main*, (French term,) a military expression, denoting an instantaneous, sudden, unexpected attack upon an enemy.

*Dulce et decorum est pro patria mori*, It is delightful and glorious to die for one's country.

*Effigies Seb. Caboti Angli filii Joannis Caboti militis aurati*. As will be seen by the text, where this inscription occurs, (p. 121,) there is an ambiguity in the application of the last two words. The other part of the inscription, may be rendered, "the portrait (or likeness) of Sebastian Cabot, of England, son of John Cabot." *Miles*, or *militis*, means, literally, a warrior, or soldier, or officer of the army; and in the English law, sometimes indicates a knight. *Auratus*, or *aurati*, means gilt, gilded, or decked with gold. *Eques* means a horseman, or knight, who was frequently called *eques auratus*, because, anciently, none but knights were allowed to beautify their armor, and other habiliments, with gold.

*En masse*, in a body, in the mass, altogether.

*Eques*, and *Eques auratus*. See *Effigies*.

*Fascine*, (pl. *fascines*,) a bundle of fagots, or small branches of trees, or sticks of wood, bound together, for filling ditches, &c.

*Formula*, (pl. *formulæ*,) a prescribed form or order.

*Geodetic*, relating to the art of measuring surfaces.

*Gramina*, grasses.

*Green Mountain Boys*, a term applied, during the Revolutionary War, to the inhabitants of Vermont, (Green Mountain,) particularly those who were in the army.

*Gymnotus*, the electric eel.

*Habeas Corpus*, "you may have the body." A writ, as it has been aptly termed, of personal freedom; which secures, to any individual, who may be imprisoned, the privilege of having his cause immediately removed to the highest court, that the judges may decide whether there is ground for his imprisonment or not.

*Hipparchus*, a celebrated mathematician and astronomer of Nicæa, in Bithynia, who died 125 years before the Christian era. He was the first after Thales and Sulpicius Gallus, who found out the exact time of eclipses, of which he made a calculation for 600 years. He is supposed to have been the first, who reduced astronomy to a science, and prosecuted the study of it systematically.

*Loyalists*, *Royalists*, *Refugees*, and *Tories*. In the times of the Revolution, these terms were used as technical or party names, and were sometimes applied indiscriminately. Strictly speaking, however, *Loyalists*, were those whose feelings or opinions were in favor of the mother country, but who declined taking part in the Revolution; *Royalists*, were those who preferred or favored, a kingly government; *Refugees*, were those who fled from the country and sought the protection of the British; and *Tories*, were those, who actually opposed the war, and took part with the enemy, aiding them by all the means in their power.

*Magnetic Variation*, a deviation of the needle in the mariner's compass, from an exact North and South direction.

*Master-at-arms*, an officer appointed to take charge of the small arms in a ship of war, and to teach the officers and crew the exercise of

ring it all the time. Of course I do not make it every time it is wanted, for sometimes, when I want it extra good, I boil and stir it a full hour, and then I put it away in a close vessel and in a cool place. For Raymond, or for any one getting well, and free from fever, I put in a third wheat flour, and half milk. You see it is a very simple process, sir."

"Yes—simple enough. But it is to these simple processes that people will not give their attention."

Mary had the happiness of seeing Raymond sitting up before their parents returned, and when they drove into the great gate, and up the lane, he was in his rocking-chair by the window, watching for them. They had heard of his illness, and were most thankful to find him so far recovered. The Doctor chanced to be present when they arrived. "O, Doctor!" said Mrs. Bond, after the first greetings were over, "how shall I ever be grateful enough to you?"

"I have done very little, Mrs. Bond," replied the honest Doctor. "In Raymond's case, medicine could do little or nothing. Nature had been overtaken, and wanted rest and soothing. Under God, Raymond owes his recovery to Mary."

"O, mother!" exclaimed Raymond, bursting into tears, "she is the best sister in the world!"

"She is the best sister in the *two* worlds!" cried little Grace Bond, a child of five years old.

A source of true comfort and happiness is such a child and such a sister as Mary Bond!—a light

us, as soon as we are missed ; let us keep on and perhaps we may find some other path.”

The poor children proceeded on their course, unconscious that every step was taking them deeper into the forest, until, completely bewildered by the thick darkness, and overcome with fatigue, they could go no further. “Let us pray to God, and then we can lie down, and die in peace,” said George ; and the innocent children knelt down on the fallen leaves, and lisped their simple prayers, as they were accustomed to do at their mother’s side.

“We must try to find some shelter, George,” said Kate, as they arose from their knees, “this chill air will kill you, even if we escape the wild beasts.” As she spoke, the light of a young moon which faintly illumined the depths of the wood, enabled her to discover a hollow log lying near. Tearing off some branches from the brittle hemlock tree, she piled them around the log, in such a manner, as to form a sort of penthouse ; and, placing George within the more effectual shelter of the log, she lay down by his side. Worn with fatigue, notwithstanding their fears, the children soon fell into a profound sleep ; and the beams of the morning sun, shining through the branches which formed their covering, first awoke them from their peaceful slumbers.

Their little hearts swelled with gratitude to the merciful God, who had preserved them through the perils of the night, and the morning hymn which was wont to resound within the walls of their

# Current Wine

1 Qt juice -  $3\frac{1}{2}$  lb Sugar or 3 lb  
add water to make up a gallon.  
bottle & cork - bung up tight  
Ed. Rice

1 Gallon juice, 3 Gallons water -  
1 lb to 1 lb Sugar, or  $3\frac{1}{2}$  lb to each gallon  
Bull, Concord -

add a bit of tartaric acid to the  
wine put in a cork with a  
a soft light to draw off the  
residue.

1880

1880

1880

1880



Glafus & Chicago Board Trade 1859

No 1. White Wheat,	Plump, Clean,	Pure.	60
" 2. "	Sound, Dirty.		
No 1. Red "	Plump, Clean.	Pure.	
" 2. "	Sound, Dirty.		
Rejected unground	with an amount of the best of it		45%
No 1 Spring "	Plump, Clean.	Pure.	58%
" 2. "	Sound, Dirty.		52%
Rejected.	do.	do.	45%

Corn

Corn	56%
Barley, Scotch	6.
Oats	30.
Wheat	60.
Salt	70.

1. The first part of the document  
describes the general situation  
of the country and the  
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