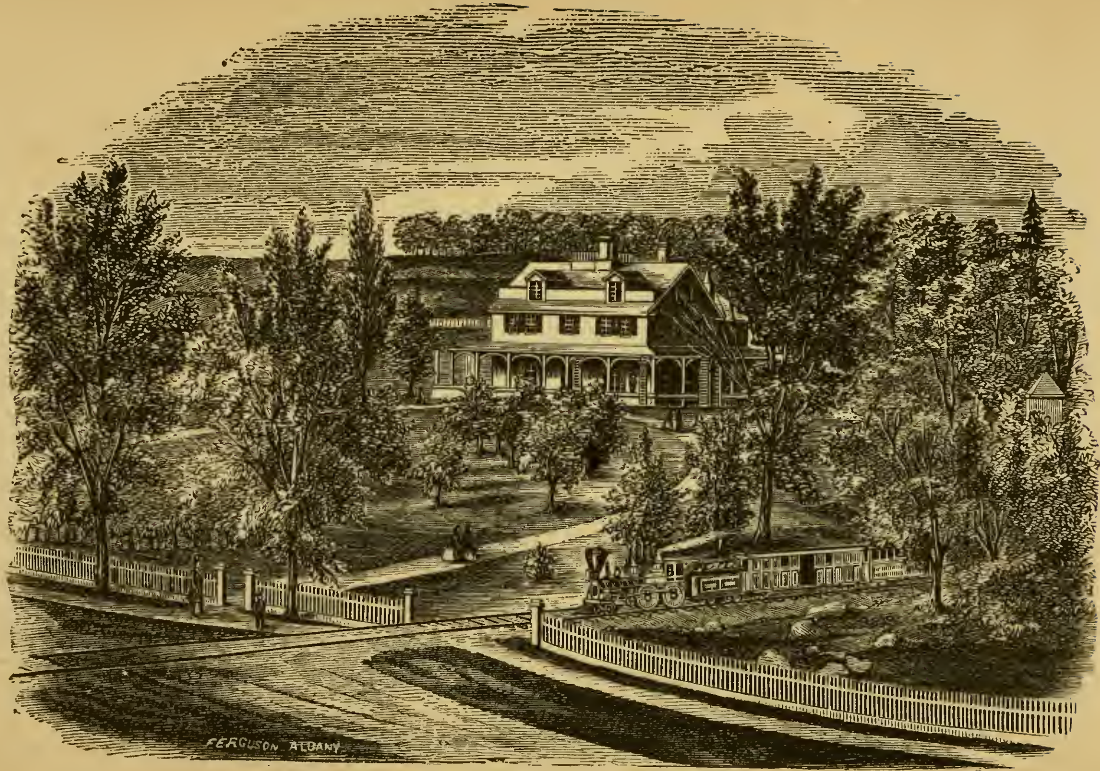

RESIDENCE OF ALEXANDER HYDE, LEE, MASS.

AGRICULTURE.

TWELVE LECTURES

ON

Agricultural Topics,

DELIVERED BEFORE THE LOWELL INSTITUTE, BOSTON, MASS.,

BY

ALEXANDER HYDE.

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PREFACE.

THE following Essays on Agriculture were originally delivered before the Lowell Institute in Boston, and were subsequently published in *The Springfield Republican*. Many who heard them in Boston, and many more, who have read them in *The Republican*, have requested that they might be published in a more permanent form. These essays do not profess to form a complete treatise on agriculture, but only to discuss some of the most important topics of this great science. As they were originally delivered in the form of lectures, it was necessary in order to preserve the unity of a lecture, that one topic, and only one, should be discussed at a session, and the author selected those subjects which he deemed of most general interest. The essays embody the results of many years' study and practice, and if they shall prove a valuable addition to the agricultural literature of the country, the highest ambition of the author will be gratified.

LEE, MASS., *October* 1, 1870.

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LECTURE FIRST.

CHAPTER I.

AGRICULTURE AS A PURSUIT.

WE live in an age of progress. The time foretold in holy writ, "When the ends of the earth should be brought together," has come. "Many are running to and fro and knowledge is increasing." We are among those who believe that every age has been an age of progress, that knowledge has ever been on the increase. It seems to us absurd to suppose that the wit and wisdom of one generation are wholly lost in the next, that each individual must work out for himself the problem of life, unaided by the experience of those who have gone before him, that nations rise and fall groping their way in darkness with no light thrown on their path from the history of preceding nations. Neither sacred nor profane history, neither prophecy nor fact, justify us in taking so gloomy and discouraging a view of life. True, the progress in the early ages of the world was slow. History was then unprinted. The accumulations of wisdom were poorly transmitted by manuscripts, monuments and tradition. Paper was unknown, and a parchment manuscript was a luxury too costly except for princes and nobles.

The invention of printing acted on the slow progress of knowledge and the intellectual life of man, much as a drain acts upon a meadow, which from time immemorial has been covered with stagnant water, rendering all vegetation slow, uncertain and coarse. Let drain-tile be introduced beneath the surface of such a meadow, and the accumulated deposits of earthy and vegetable matter are at once ready to furnish food for new and beautiful life. The field that was so long struggling to rise from the slough of despond by slow deposits on its surface, now finds itself suddenly elevated into the region of air and sunshine, and is clothed with verdant and nutritious grasses.

Such was the effect of the printing-press upon the accumulated wisdom of the world. It gave currency to thought. Wherever its influence was felt, mankind were elevated into light and a new life. Steam and electricity have wonderfully accelerated the progress of this new life. Time and space are almost annihilated by their magic influence. We can travel farther, see more and learn more in one year than our fathers could in half a life-time. Every science, every art has felt the electric impulse. Agriculture is no exception to this remark. Though slow to move, it has felt the power of the current which is bearing forward all physical and metaphysical knowledge with an irresistible force.

The science of agriculture is, however, still in its infancy. As an art it has existed from the time when Adam was placed in the garden of Eden, and it may seem strange that an art which has been practiced as long as man has existed on the earth, and has occupied the attention of the great majority of men, should be so slow in attaining to the dignity of a science. It must be remembered, however, that chemistry, botany, geology, zoology and electricity are also modern sciences. The rocks, plants and animals have existed longer on the earth than man, but the scientific investigation of the rocks is comparatively recent. From the crumbling of the rocks by the action of air and water, and the crushing of them by vast glaciers and other mechanical means, the soil has been formed from which all plants and animals derive their nourishment, but it was left for modern science to analyze the rocks and to study their history, written as it were with a pen of iron on their face. Plants have existed from the time when the Creator said, "Let the earth bring forth grass, the herb yielding seed and the fruit tree yielding fruit after his kind whose seed is in itself." We have cultivated these plants, and they have been our support from the creation till now, but neither Moses, learned in all the wisdom of the Egyptians, nor Solomon, who gave his heart to wisdom, and spake of all the trees from the cedar of Lebanon to the hyssop that springeth out of the wall, nor Socrates, the wisest of the Greeks, nor Cicero, the Roman philosopher, nor even Lord Bacon, the giant of English intellects, could analyze a leaf and tell its elementary constituents.

The lower animals came to Adam to be named, and they have been man's constant companions and allies in all ages; still zoology is a modern science. The Greeks knew that amber when rubbed would attract light substances, and they called this power "electron," but this was pretty much all they knew of electricity, which now looms up in such vast proportions and is revolutionizing the business of the world. These are the sciences which are the progenitors of the complicated science of agriculture, and we must not blame the farmers for not working out the theory of their occupation, when men,—philosophers as well as fools,—lived till the days of William Harvey without understanding the theory of the circulation of the blood.

When we consider the extensive and complex relations of the science of agriculture, we do not much wonder that it is still in its infancy. The truly scientific farmer needs all the wisdom of the geologist, the chemist, the mineralogist, the botanist, the zoologist and the mechanic. The whole range of physical science pours its contributions into the lap of agriculture.

Let no one, however, be discouraged by this from the practice of an art which is so simple that too many have thought it to require only the exercise of muscular force, guided by the smallest modicum of intellectual ability. It is one of the beauties of the art that all men, whether learned or unlettered, can practice it. The simpleton may possibly hold his plow and sow his seed as well as the wisest of philosophers, and a mind as great as that of Daniel Webster may find ample scope for investigation upon the farm. We very much doubt whether Uzziah, one of Israel's most prosperous kings, who is described "as loving husbandry and having much cattle, both in the low country and in the plains; husbandmen also, and vine dressers in the mountains and in Carmel," knew as much of the laws of breeding cattle, or of the chemistry of wine manufacture as the majority of the graduates of our high schools. He was, however, a prince among husbandmen as well as a mighty ruler, "for he loved husbandry."

Agriculture is not like painting, poetry and other fine arts, in which only the few who are born painters and poets can hope to succeed. Farmers are made, not born. The art is of so universal necessity that any degree of excellence in it is desirable. Any man that makes two blades of grass grow where one grew before, deserves and receives credit for his skill. If he makes ten blades grow instead of one, we give him still greater credit. No matter whether he tills one acre or a hundred or a thousand,—if he cultivates well what he undertakes, he will find great satisfaction in the employment; and an acre will furnish far greater scope for mental and muscular exercise than is commonly supposed.

Agriculture is unlike other arts, also, in the almost universal love which mankind have for it. A father, in the selection of an occupation for his son, if he is a wise man, will consult the bent of the boy's genius, and will not undertake to make a mechanic of him, unless he shows an aptitude for the use of tools, much less will he apprentice him to a painter, unless the lad shows a decided taste for this fine art. Many a good farmer has been spoiled in the vain attempt to become a minister. The love of agriculture, however, is so universal, and life in the country is such a normal condition of man, that, no matter what else our taste and talents may lead us to pursue, we have never yet met with a man who did not desire to be a landlord, to sit under his own vine and apple tree, and enjoy the fruits of his own labors, which mother earth holds out with a full hand to those who cherish her in ardent love. We have met with men too lazy to work, who sneered at farm life as one of unremitting toil, and preferred some other occupation in which they could earn a living with less sweat of the brow, but men who are afraid of work are not destined to excel in any business or profession, and are drones living on the honey collected by others, no matter whether they are farmers, mechanics or professional men. Labor on a farm is no more uncongenial to them than labor in the shop and office. These same men all acknowledge the pleasure and independence of rural life, but unfortunately

> "He that by the plow would thrive,
> Himself must either hold or drive;"

and however pleasurable the thrift may be, the driving is decidedly uncongenial. We know a farmer who sits in his house of a pleasant June day, enjoying the soporific influence of his pipe, and occasionally saying, "I wish them potatoes were hoed." It cannot be said of such an one that he has great relish for agricultural pursuits, but he probably does as much at farming as he would in merchandising or manufacturing. In either of these occupations he would be distanced by his competitors, and probably become an object of charity, but, notwithstanding his shiftless, lackadaisical mode of farming, he raises pork and potatoes enough to keep soul and body together. Many a professional man, with his head aching with the perplexities of his business, sighs for the quiet, simple pleasures of farm life, and many a merchant constantly on the *qui vive* to outstrip his competitors in trade, and fearing commercial revulsions which may strip him of the results of a life of toil and enterprise, longs for a home in the country, where he may spend quietly the evening of his days. A professional man with a brilliant genius, fitting him "to govern men and guide the State," and shine in the most polished society, recently said to us, "Can I manage a few acres of land? I long to be the owner of some land and a tiller of the soil." This longing, we think, is pretty universal. Tilling the soil is the primeval occupation of man, and we inherit from father Adam the love of the ancestral business, which the ardent pursuit of no other calling fully eradicates.

CHAPTER II.

DIGNITY AND PLEASURES OF FARM LIFE.

WE therefore say without fear of contradiction, that more men are fitted by natural taste and capacity for farming than for any other occupation. We go further and say there are few men with tastes so perverted and capacity so small who can not earn a comfortable livelihood by agriculture. We have in our mind's eye now, a man who by some hook or crook entered one of our New England colleges. How he passed the ordeal of examination we never knew, but the keen eyes of his fellow students soon discovered that he was not fitted for a college course, indeed that his wits were barely sufficient to keep him out of the fire. They did not keep him from the fire of ridicule, which soon became so hot that by the force of public opinion, not by the interference of the faculty, he was compelled to leave college and retire to a farm. Strange as it may seem, he made a good farmer, managed successfully two hundred acres of land and a large herd of cattle, and had money to lend to whoever would give him ample security. The adaptation of agriculture to all degrees of intellect is truly wonderful. Daniel Webster, the type of intellectual strength, found ample scope for his powers upon the farm, and the dwarfed capacity of the Irish peasant has been found adequate to the management of land, and he sometimes manages it with exceeding skill.

The adaptation of agriculture to all ranks and conditions of society is not less wonderful. The king himself, without any loss of dignity, can be a farmer. Most of the presidents of these United States have been farmers, and have retired from their high position to the cultivation of their broad acres. We should be sorry to see a president reduced to selling lace and broadcloth, but of Washington as a farmer, we are almost as proud as of Washington the president. Adams on his farm at Quincy, Jefferson on his estate at Monticello, Jackson at the Hermitage, were just as dignified as when in the presidential chair. Van Buren prided himself as much upon his large patch of cabbages at Kinderhook as upon his sharp diplomacy at Washington. Clay, surrounded by his short-horns at Ashland, was as much a nobleman as when gazed upon with delight by his compeers in the Senate chamber. The massive intellect of Webster was as conspicuous in the guidance of his farm at Marshfield as when he guided the affairs of State.

The philosopher and the peasant meet on common ground when they meet on the farm, and it would be strange if the philosopher could not learn something from the peasant, as well as the peasant from the philosopher; and in this exchange of thought, as well as in the balance between brain and muscle, each finds his own dignity and self-respect supported.

Prince and peasant alike feel that in cultivating the soil they are fulfilling the mission which the Creator gave to man when he placed him in the garden of Eden. The pleasure, too, which the cultivator feels in raising his own fruits and flowers is very analogous to the pleasure of the Creator when he looked upon the works of his hands and pronounced them good. We doubt not there is pleasure in the successful prosecution of any branch of useful industry. The conversion of cotton and wool into fabrics for the protection and adornment of our persons, is a species of creation, a remoulding of raw material into forms of beauty and utility, which must give the manufacturer great satisfaction; but this does not seem so much like a miracle as the creation of new life from inert matter, a transformation which the farmer constantly sees going on around him, and in the conduct of which he has a directing agency. In the case of the manufacturer, no new life is the result of his skill and labor. Matter is transformed and is made useful and beautiful; but cloth, glass and paper have no life.

Not so with the products of the farm. Here dead, inert matter is transformed, not only into a thing of beauty and utility, but becomes also a thing of life. An apple lives and grows, and this vegetable life is destined to enter into the composition of a still higher organization in animal life. How the vile, offensive matter in the compost heap is converted into the luscious and fragrant peach, is beyond the power of human ken to discern. It is a living, perpetual miracle, attesting the wisdom and power of the great Creator; but the farmer acts an important part in the transformation. He prepares the compost, determines whether it shall fertilize a melon or a cabbage, sows the seed, and cultivates the plant, and so is, at least, a co-worker with the First Great Cause, and shares with him the pleasure of creation, as, it seems to us, the worker in no other branch of industry can.

In planting a tree and watching the expanding bud, the opening blossom and the maturing fruit, there is certainly a pleasure which the mere consumer does not and can not enjoy. It has been said that "an undevout astronomer is mad," and it seems to us that an undevout farmer is equally insane. All his life-time he works side by side with the Creator, and must feel his dependence upon a higher power for the sunshine and the rain, and upon a wisdom higher than that of any chemist, decomposing and recomposing in the laboratory of nature the atoms of matter which are too small to be seen by the human eye. We talk about making this and that to grow, but how small really is the agency which man exercises in the creation of new life. We are the engineers of the train, but the power which moves the whole is without and above us.

Poets, who are supposed to see further into the depths of human passion, and to understand the hidden mysteries and the problems of life better than common folks, have always pictured the highest happiness in rural life. How absurd it would be for a poet to describe a paradise in the city. Imagination, in her highest conceptions for the abode of man, always places him in some Arcadia, surrounded by trees and flowers, the music of the birds, the murmurs of the running brook, and all the forms of animate life. "God made the country, man made the town," and as the works of God are infinitely superior to those of man, so the pleasure derived from the observation of the works of the Creator is immeasurably greater than that derived from those of the creature.

There is a majesty and beauty, a perfectness of mechanism and coloring in nature, which art in vain tries to imitate. If we examine the point of a thorn under a microscope we find it truly a point, having position without magnitude; but if under the same instrument we examine a cambric needle, it has much the appearance of a common crow-bar. In the same manner, if we examine the texture of a leaf, its delicate mechanism is all the more apparent; but the finest product of the loom, when largely magnified, seems too coarse for the garments of civilized life. Those doomed to live incarcerated within the brick walls of a city endeavor to import into their prison-like abodes some of the beauties of the country. A few plants in the conservatory serve to give them some notion of the rich coloring of nature; a caged bird or two hung up in the halls give a few notes and a few snatches of the tunes which the great orchestra of birds is constantly repeating in the fields; and a few paintings hung on the walls give but a poor representation of the landscapes which the farmer has but to open his eyes to enjoy in all their magnificence and beauty. Life, music and motion can not be transferred to canvas. The trees, flocks and herds of Arcadia can be painted, and the nearer the picture comes to a representation of the real scene, the more we admire it; but the waving of the leaves, the lowing of the cattle, the bleating of the sheep and the frisking of the lambs can not be delineated.

Then, in the country we have the free air of heaven uncontaminated,—a boon of inestimable value. Good air is a blessing so cheap that we do not value it as we should. By the air our blood is vitalized momently, and without air we cease to live. Food we may take at intervals of hours, but from the air we draw our life constantly, and upon its purity much of the comfort and happiness of life depends. In the normal condition of life in the country, a kind providence has wonderfully provided for the preservation of the proper constituents and just proportions of the elements of the air. There is no increase of vitiated gases, no stagnancy. The growing vegetation absorbs from the air the carbonic acid just

as atmospheric contaminations of crowded cities, can congregate in the avenues of trade; but when fortunes are made and gray hairs begin here and there to appear, the country furnishes a refuge from the high pressure of city life, and agriculture is just the employment to keep the mind and muscles in healthy exercise during the evening of one's days.

It is a great mistake, but one frequently made, to retire from active business, go into the country, build a cottage or a palace, without engaging in rural pursuits. So long as building and the improvement of the grounds occupy the attention, the time passes pleasantly; but as soon as this excitement is passed and the mind is unoccupied, the days grow long and wearisome. The truth is, God never made man to be idle, for He works and finds his highest enjoyment in the constant exercise of his infinite faculties, governing the universe in wisdom and love. We are made in his image, and if we would enjoy life we must, like our Creator, "go about doing good." Work, both of body and mind, is the normal condition of man. The muscles, unexercised, become weak and diseased; and the mind, unoccupied, preys upon itself, just as the gastric juice, with no food upon which to operate, irritates the coats of the stomach. Hence, we see numbers who have retired from the excitements of business, and have built for themselves magnificent homes in the country, soon become disgusted with the monotony of their life, sell out at a great sacrifice, and again plunge into the whirl of speculation. If these same men had, with their own hands, planted their gardens, set out an orchard; had bought a small herd of Jerseys and personally tended them; had erected a temple for their Brahma hens and paid their daily devoirs there in search of eggs; had studied the character and habits of that most noble animal, the horse, and by care and kindness had won the confidence of one of the noblest of his kind; had built a dove-cote, filled the air with doves, and watched the motions, the billings and cooings of these most beautiful and loving birds, chosen in Holy Writ as the emblem of the Holy Spirit; our word for it, they would never have been willing to exchange their country home, with its verdant lawns and landscapes, its fruits and flowers, its domestic comforts and domestic animals, its pure air and ample elbow room, its neighborly sympathy and quiet social enjoyment, for a pent-up residence in the city. It is not strange that some who go into the country, and engage in the pursuits of agriculture, should make shipwreck of their happiness. If mammon is the god they serve, and the rapid accumulation of gain is the end aimed at, they are doomed to disappointment. "The golden stream may be quick and violent" in the city, but in the country it is slow and sure, too slow perhaps for Young America, but rapid enough for those who have passed the meridian of life.

In cultivating the garden, in planting fruit and shade trees, in tending flocks and herds, in breathing the pure air, in cherishing all family and neighborhood virtues, in studying the science and improving the art of agriculture, in fostering the benevolent, literary and religious institutions of the community, and in the enjoyment of an enlarged hospitality,—a healthy stimulus will be given to all the powers of mind and body which age ought to exercise. Happiness has been defined to consist in the healthy exercise of all our faculties, and if all these faculties are anywhere brought into requisition, it is on the farm. There is no end to the amount of knowledge and quantity of labor demanded in agriculture. We have heard farmers speak of their spring work and summer work being finished, but we could never finish spring work till the spring was finished, and were fortunate if some of it did not lap over into summer. Farm work, like woman's, is never done, and no man, young or old, with a few acres of land around him, need ever fear being without employment, and if he loves his work, he will not be without enjoyment.

CHAPTER III.

IMPORTANCE OF AGRICULTURE TO SOCIETY.

WE have spoken of the adaptation of farm life to all capacities and all ages, and of the pleasures incident to this pursuit. Our subject will not be complete unless we also speak of its fundamental importance in the economy of society. Agriculture was not only the primeval occupation of man, and the pursuit which the majority of men in all ages have followed, but it has been, is, and ever must be the main spring of all industry. All are dependent upon it for their daily sustenance. "The king himself is served by the field. The profit of the earth is for all." The banker and the beggar, the prince and the peasant, are alike fed from the products of the soil. Nothing can supply the place of these products. All the gold of California, and all the Erie railroad stock, multiplied indefinitely, cannot keep the soul and body of man together. No matter what business we pursue, we must, like the fabled Antæus, draw our life afresh every day from mother earth. The philosopher poring over his musty volumes, lost in the region of thought, may forget for a time whether he is in the body or out, but at length

> "Begins to feel, as well he might,
> The keen demand of appetite."

The metaphysician, soaring in the regions of speculation, may imagine he has risen above all physical wants, and may despise everything earthy, but, like Dædalus, he has to come back to the earth for support. Our daily bread can come in no other way than from the tillage of the ground. If we ask it of the chemist, he may tell us its principal elements and the proportions in which they are combined; he may, indeed, furnish, by decomposition, the carbon, oxygen, nitrogen, hydrogen, phosphoric acid, lime and soda, of which bread is mainly composed; but for all the sustenance these elements can furnish us, he might as well have given us a stone. Ask for bread of whom we will, and search for it where we may, and we shall find it a fundamental principle that our life must be sustained either by our own or others' culture of the soil.

This culture not only gives life to man and beast, but is the foundation of all other business. All trades and manufactures, all commerce, in short all business, is the result directly or indirectly of agriculture. The thousands of wheels which are revolving in Massachusetts to-day, whether moved by water or steam, are only re-moulding the products of the earth into some useful form, and the thousands of ships which are traversing the oceans and rivers of the world are merely transporting these products, either in a raw or manufactured state, to a market. The merchants, whether wholesale or retail, are the mediums of exchange for the produce of the soil. The millions of money deposited in our banks represent the capital accumulated from this produce. Our costly and commodious public buildings, our beautiful private residences, our splendid turn-outs, the adornments of fashion, indeed all the representatives of value,—are the ultimate results from the crops of the earth. A merchant prince once said to us, pointing to his splendid mansion in the Fifth Avenue, "Every stone in this house is the result of the prairie soil of Illinois." Were the annual harvests of the earth to cease, the whirling spindles and flying shuttles of our manufactories would also cease, our ships would rot by the wharves, and our banks would have no demand for discounts. When the labors of the husbandman are rewarded with bountiful harvests, the spindles multiply, the ships are well freighted, and money is current. The resources of a country exist mainly in the soil. Our ability to pay off our immense national debt depends upon our harvests. To our husbandmen we look for the labor, and to a kind Providence for a blessing on this labor; and the burden which now presses so heavily upon our shoulders will be lifted off. We are blessed with an almost unlimited amount of territory. Land in this country is almost as free as water. Any man can own a farm by squatting and cultivating.

As the area of our soil is unlimited so also is its productiveness. Who will dare to put a limit to the production of an acre of land? We might as well put a limit to the capacity of man, or the influence of woman. If any one had told us ten years since, that an acre would produce an hundred bushels of oats, we should have been faithless, but our faith has since been swallowed up, if not in sight, at least in hearing. One of our neighbors, in whose integrity there can be no question, has returned over his signature, duly sworn to, one hundred and nine bushels of oats as the product of one acre, and when questioned by an incredulous friend: "How he knew that he raised so many on an acre?" he straightened himself up in conscious integrity, and replied, "I measured the land and weighed the oats myself." Some of our eastern friends, we believe, are still doubtful whether an acre ever produced a hundred bushels of shelled corn, but we have no reason to doubt this, if any confidence is to be placed in man or steelyards. The earth can be made to return thirty, sixty, a hundred, or even a thousand fold ; the quantity, under the blessing of Providence, varying much as our skill and labor vary. As the skill of man is unlimited, so must the capacity of the soil be.

This leads us to say that it is only when science and practice are combined, that we can expect the highest results from agriculture. We have spoken of the art as adapted to the highest and lowest intellectual capacity. This is in a measure true of any art. A sailor, with no pretensions to a knowledge of the science of navigation, can by the aid of tables and charts prepared by others, steer a ship across the ocean, but should his tables be lost, he would make poor steerage. Science enables a man to take his bearings and calculate his distance and departure under all circumstances. No art is so greatly indebted to science as agriculture, as all sciences combine to promote its advancement; but, strangely, farmers have not generally felt the obligation, and have sometimes sneered at book-farming, as they have been pleased to term scientific agriculture. Seemingly they have not been aware that all practice must be founded upon knowledge or science, (for the terms are nearly synonymous,) and the only question is, whether our practice must be guided by the knowledge derived from our own limited experience, or from the accumulated wisdom of all nations and all ages.

We have given a fundamental position to agriculture among the many arts which minister to the necessity and comfort of man. We believe this is strictly true, but we must not be understood as undervaluing other branches of industry. All are necessary for the perfection of social life, and as civilization advances, the ramifications of industry multiply; but what we insist upon is, that they all branch out from agriculture, and draw their life from this great trunk. "As in the body we have many members, but all have not the same office, and as the eye can not say unto the hand, I have no need of thee, nor again the head to the feet, I have no need of you," so in the body politic we are all members of one common body, and there should be no schism; all the members should have the same care one for another, as when one suffers all suffer with it, and when one is honored all should rejoice with it. In New England, we are greatly blessed in having the ramifications of business largely multiplied and in close contact. Each gives a stimulus to the others.

We greatly fear that the agriculture of New England, resting as it does upon a comparatively barren soil, could not have successfully competed with that of the prairie and bottom lands of the West, had not manufactures sprung up and furnished a home market. When the strength of the virgin soil had been exhausted, our farmers would have sought a more genial climate and fertile land, and where now are populous cities and thriving villages, surrounded by green meadows, fields of waving grain, blooming orchards and luxuriant gardens,—there, had not manufactures lent a stimulus to agriculture, in all probability forest trees would now be growing, and slowly restoring the soil to its original fertility. As it is, our mountain towns, and those remote from railroads and centers of business, are decreasing in their population and the amount of their agricultural products. Farms are being absorbed into one another, and real estate has fallen in value so much, that many farms can be bought to-day for less than the cost of the buildings upon them, and in some cases for even less than the cost of the fences. While this is the sad truth in relation to places where agriculture is the sole pursuit, unstimulated by a home market, which other branches of industry furnish, we see real estate, in the vicinity of manufacturing villages and marts of trade, steadily rising in value. We have known a few square rods of land, sufficient barely for the erection of a building, sold for three times the amount at which the whole farm of one hundred acres was valued a few years since. While on the mountain and in the purely agricultural towns, little drainage is being done and comparatively few improvements are being made; in the neighborhood of manufactures, the swamps and wet lands are drained, the high places are brought low and the rough places made smooth, and thus the way is prepared for the mowing-machine. When various branches of industry are co-operative, then it pays to make improvements in agriculture. They operate on each other, obey the law of induction, much as do the north and south poles of the magnetic needle,—the greater the northern polarity, the greater the southern, and with increased southern polarity at one extremity of the needle comes increased northern at the other; so with more extensive manufactures comes a more improved agriculture, which again reacts in favor of manufactures. Hence the jealousy sometimes cropping out between farmers and manufacturers is foolish and suicidal. There is no antagonism between the different trades and professions.

The fine arts also have their appropriate sphere. They serve to embellish life. They satisfy the craving of the eye for beauty and the longing of the ear for harmony. The world was not made for utility alone. In delineating a beautiful landscape, the painter is but imitating the Creator, who, when he made the world, adorned it with a lavish hand. There is beauty all around our path, and they make a great mistake who go through life, keeping an eye out only for the useful.

While we thus accord to all trades and professions their due honor, we still contend that God, by placing Adam in the garden of Eden, and by implanting in his posterity an almost universal love of agriculture, has clearly indicated that in this pursuit the perfection of manhood and the highest enjoyment of life are to be found. Certain it is that the great majority of mankind in all countries are engaged in agricultural pursuits; and we fully believe that in no occupation is there so much quiet enjoyment, such a feeling of independence, such a constant and pleasurable excitement, that gently stimulates without overtasking the mental and physical energies. An extensive manufacturer, who in former years has expatiated to us on the pleasure he derived from the music of his water-wheels, and the satisfaction he found in guiding the labors of a multitude of men, and seeing the town prosperous from the stimulus which he gave to business generally, has lately turned his attention to agriculture, and confesses that he finds in his new pursuit an enjoyment he never experienced before. Living in the open air, and exercising his muscles more vigorously and his brains more gently, dyspepsia, which formerly tormented him, has disappeared. He finds the sleep of a laboring man sweet, whether he eats little or much. In draining his swamps and creating fertile land from a worthless bog; in tending his herds and studying and developing the good points of his animals; in planting his vines and fruit trees, he says he finds a pleasure which the old mill never gave. We know the source of the pleasure of life is mainly in the man, not in his occupation; still it can not be denied that some pursuits are more conducive to happiness than others. It is well that we have different tastes. If all men thought as we do, all men would be emulous to be farmers.

CHAPTER IV.

DOES FARMING PAY?

BUT some one may say, "I am satisfied that farming is an independent, healthy, pleasant pursuit, but does it pay?" To this we answer, it must pay, for by it the great majority of men are at this moment earning their living. We have the highest authority for saying that, "in all labor there is profit, and much increase is by the strength of the ox," and "He that tilleth his land shall have plenty of bread." Still the general impression is that the gains of the husbandman, though sure, are slow, and this is the correct view of the case. Speculation is not legitimate farm business. The husbandman receives a thousand fold for the corn which he plants, but the return is after much patient toil, and he verifies the prediction made to Adam, "In the sweat of thy face shalt thou eat bread." Farm stock can not be watered like railroad stock, and made to expand at pleasure. Those who go into farming expecting to make sudden fortunes, will be disappointed. It is a highway to health and competence, but not to wealth and luxury; but as a "competence is all we can enjoy," we say with the poet:

> "Oh, be content when Heaven can give no more."

While we concede that the profits of farming are slow and sure, rather than rapid and uncertain, we still maintain that no business pays better in the long run for the capital and skill invested. Farmers never fail. While 90 per cent. of those who enter upon a mercantile career become bankrupt, it is an anomaly for a farmer to ask his creditors to take fifty cents on a dollar. We never hear of farmer princes, and we can not point you to millionaires among husbandmen, but we can point you to thousands and tens of thousands among the cultivators of the soil who are independent as any prince, and live surrounded with the comforts, if not the luxuries, of life, all earned from the bountiful earth. The number of these might be increased indefinitely, if more intelligence, and more system generally, attended the labors of the husbandman. In this, as in every other pursuit, it is intelligent labor that commands success. Were a manufacturer to conduct his business in the shiftless manner in which many farmers direct their affairs, he would speedily come to the end of his career.

The farmer, in many cases, lives and makes his ends meet, not because of his enterprise and skill, but because he has little at risk; and the bountiful earth and the propitious skies cause his crops to grow, even when little thought has been bestowed upon their cultivation. Grass grows with little or no attention paid to it, and cattle will eat it and convert it into milk and beef with little human effort in guiding them, so that a farmer may manage to live with no great exercise, either of his mental or physical energies. This, however, is rather vegetating than living. Neither the profits nor the pleasures of such farming are great. With shame we confess that this is the type of farming which has been too prevalent in the country. By close economy and deprivation of the comforts of life, by saving rather than by earning, such farmers may live, may possibly lay up a little extra money, but it is done at the expense of true manhood, and of all the higher social, intellectual and moral enjoyments.

It is gratifying to know that a brighter era is dawning upon our agricultural population. Thought has been stimulated by the numerous agricultural societies and papers that have sprung up like mushrooms in the land. Book-farming is no longer sneered at. It is universally conceded that the field for scientific investigation in agriculture is wider than in any other art, and science is turning her attention in this direction with a zeal worthy of all praise. After a long struggle, we have an agricultural college firmly established in this State, with a scientific and energetic man at its head, an able corps of instructors, and nearly a hundred students gathered from all parts of the State, from whom we expect much in elevating the calling to which they are devoting four years of preparatory study. The Cornell University has also recently commenced a vigorous career on a munificent foundation, principally laid by the benevolence of Ezra Cornell, who for years has been bringing the ends of the earth together by means of telegraphic wires, and having amassed a fortune by his enterprise, is spending it in advancing the interests of science, with agriculture as one of the leading objects of his institution. Agricultural colleges are also dotting the western prairies, and boards of agriculture are being organized in all the states, modeled after the Massachusetts board, which has done such signal service for the cause of agriculture in this State.

The isolated life of the farmer has been in a measure broken up. Farmers' clubs and farmers' conventions have called them together, and they are comparing notes and learning from each other's experience. This isolation has been one great barrier to the farmer's progress. He has relied too much on his own limited practice and observation. We have recently attended some conventions of the farmers of the Housatonic valley, in which the subject of cattle husbandry, particularly with a reference to the production of milk for the New York market, has been discussed; and we have been gratified at the amount of information imparted, and the intelligence and thrift which the milk business is eliciting. Farms which a few years since carried from fifteen to twenty cows now carry from twenty-five to thirty, and the cows which formerly returned to their owners from fifty to sixty dollars annual income, now return from eighty to one hundred dollars. A large farmer from Egremont has realized on an average the latter sum from his twenty-one cows the past year, and from his experiments in feeding cut and steamed food is confident that the coming year he shall realize four thousand dollars from thirty cows. This is an income equal to that received by the judges of our superior court, and is a good answer to the question, "Will farming pay?" The number of milch cows in the State in 1865 was 143,286, without counting the 31,100 heifers; and if these cows could be made to give a return of one hundred dollars each, the income from this branch of farming alone, would be $14,328,600. If any one had prophesied, twenty-five years since, that the time would come when Massachusetts would furnish fresh milk for the New York market, we should have been as incredulous as Hazael, when told by the prophet of the cruelties he should inflict upon the children of Israel. It is within the memory of the living, and those not very old either, when it sometimes took us a week to go from

Western Massachusetts to New York. A day's journey brought us to the Hudson, where a little sloop was the only conveyance down the river, and when the wind was adverse the journey was one of several days, and at great expense of patience. Now the grass which is to-day growing on the hill-sides, is to-morrow, by a wonderful animal chemistry, converted into milk, and the next day is distributed among the two million inhabitants of New York city and vicinity, who are dependent upon the country for this necessary of life.

The increased attention paid to the production of milk is one of the hopeful signs for the future of New England agriculture. Where facilities are not offered for the transportation of milk to the city market, cheese factories are springing up, and two or three persons are thus enabled to manufacture the milk of five hundred cows into cheese, whereas it formerly required the labor of twenty-five or thirty. By this division of labor, not only are two dozen persons set free to attend to other duties, but by the greater skill, which science and practice have induced, a superior article of cheese is made, which commands a higher price in the market.

From this enhanced value of milk we expect to see increased attention paid to the development of a better breed of cows, and more care bestowed upon the meadows and pastures which furnish the raw material from which milk is manufactured. These is no limit to the production of grass which our meadows may be made to yield. The average production of hay in Massachusetts is now less than one ton per acre, as we have 506,983 acres in mowing, which produce only 476,759 tons of hay. The average may just as well be three tons, and an acre has been known to produce six tons.

The future of New England agriculture is unwritten, and we will not attempt to unroll the scroll of prophecy, but if we are any judges of the signs of the times, they augur well for the coming farmer. Our soil may be rough and rocky, but there is strength in it, and we have facilities for developing its capacity which no other part of the country furnishes. Our manufactures have only begun to contribute to our agriculture. To aid in developing this agriculture and the manhood of the farmer, is the object of this course of lectures.

We do not propose to give a full and systematic treatise on our favorite art. This would make our course of lectures too desultory. To preserve the unity of subject so essential to a lecture, we are compelled to confine our attention to topics, and shall select such topics as will be of most general interest and of the most practical value. The history of agriculture, the origin and classification of soils, fertilizers, and some of the leading branches of husbandry, will receive our chief attention.

LECTURE SECOND.

CHAPTER V.

HISTORY OF AGRICULTURE.

AGRICULTURE may be defined in its literal sense as the art of cultivating the ground, and obtaining from it the products necessary for the support and comfort of animal life; in a wider acceptation it also includes the breeding and rearing of the animals required in the cultivation of the land and in the consumption of these products.

Agriculture as an art has existed from the time when "God put Adam into the garden of Eden to dress it and to keep it;" as a science it is still in its youth, the present century having furnished more valuable contributions to the science than all the previous centuries. Indeed, Lord Bacon was so disgusted with the empiric character of all the treatises on this subject published before his day, that he burned all he had in his library, as a mass of ill-arranged, contradictory statements, saying, "In all these books I find no principles; they can, therefore, be of no use to any man." We yield to none in admiration of the genius of Bacon. We are indebted to him for the key which has unlocked the secrets, not only of agriculture, but the whole round of modern sciences."

"No man is wise at all times," and we can not applaud "the greatest of mankind" for burning the plain statements of the agriculturists of all ages, merely because they contained no general deductions for his guidance. Would it not have been more philosophical to have collated the facts contained in these books, and deduced from them general principles from which others might heve reaped benefit? It is, indeed, wonderful that an art which has engrossed the attention of the majority of men, and is essential to their very existence, should have been so long in attaining to the dignity of a science. But we must remember that other arts were equally slow in rising to this dignity. The kindred sciences which combine to make up the great science of agriculture were not developed till within the present century. Farmers have ever been working, not scientific men, and in the early ages of the world the mechanical aids in agriculture were few and imperfect, and much hard labor was in the tillage of the soil.

In the "Wisdom of Jesus, the son of Sirach," we read, "The wisdom of a learned man cometh by opportunity of leisure; and he that hath little business shall become wise. How can he get wisdom that holdeth the plow, that driveth oxen, and is occupied in their labors, and whose talk is of bullocks? He giveth his mind to make furrows, and is diligent to give the kine fodder. He shall not be sought for in public counsel, nor sit high in the congregation. He shall not sit on the judge's seat. He can not declare justice and judgment, and shall not be found where parables are spoken, but he will maintain the state of the world, and his desire is in the work of his craft."

As it was in the days of the son of Sirach, so it has ever been; farmers, though "maintaining the state of the world," have been so much engrossed with their plow and bullocks, as not to find leisure for scientific investigation, and, we are sorry to add, have not sufficiently valued the scientific researches of others. But, notwithstanding all the obstacles in the way of the progress of agriculture, we are confident progress was made, even before the days of Lord Bacon, and there is much wisdom concentrated in the writings of the Hebrew, Greek and Roman authors, to which we shall do well if we give heed.

Science is but knowledge reduced to general principles, from accumulated experience, and it is not worth while to reject the experience of all past ages merely because it has not been systematized. We do not know what books the author of "Novum Organum" burned, but we venture to say much practical wisdom could be derived from them, and not a few general principles. We should not expect to find analyses of soils, grains and roots, but we should find much common sense, mingled with some nonsense, in relation to practical agriculture.

Glory as much as we may, and as we have reason to, in our modern system of farming, and in our schools and books of agriculture, we find many of the practical rules current now-a-days equally current in the days of Greece and Rome. As Mitchell says in that captivating work, "Wet Days at Edgewood:" "There lies a mass of sagacious observation in the pages of the old teachers, which can never be outlived, and which will contribute nearly as much to practical success in farming as the nice appliances of modern collegiate agriculture." Xenophon among the Greeks and Virgil among the Romans gave some as sage advice as we can gain from any English or American author. From the "Economics" of the Grecian we give the following precept, which is as shrewd as any Yankee can furnish: "Whenever you buy land, by no means purchase that which has been already well improved; but choose such as has never been tilled for if you purchase improved grounds you must pay a high price for them, and you can not enhance their value, and must also lose the pleasure of improving them yourself." Virgil, also, in his "Georgics" insists upon the advantages of a rotation of crops, which, though taught by nature as well as by Virgil, has been slowly put in practice, even in these latter days. Virgil's aphorism, "Praise a large farm, cultivate a small one," is current doctrine now, more preached than practised. These old writers did not understand vegetable nor animal physiology, and give some precepts in grafting and breeding which make the modern student smile, but there is much good wheat mixed up with their chaff.

CHAPTER VI.

RISE AND PROGRESS OF THE ART.

FULLY believing, as we do, that the world has not repeated itself in agriculture any more than in the other arts, and that the cycles of the ages as they have rolled around, have also rolled forward, we propose to give a brief history of the rise and progress of the art. The lamp which guides farmers is the lamp of experience, but the experience of the individual is limited. "History," says Bacon, "makes the wise statesman." The history of his art is equally essential to the skilful cultivator of the soil. A complete record of the progress of agriculture in the early ages of the world is impossible. From the necessity of the case it was never a lost art, but the records of its history were few, and of these few many were lost.

Adam was the first horticulturist, and in the mild climate of Eden, fruits doubtless furnished the chief diet, and fig-leaves, we read, supplied all the requisite clothing. Cain and Abel made the first great division of agricultural labor, Cain becoming a tiller of the ground, and Abel a keeper of sheep. This distinction of tilling and grazing is the leading one even at the present day. Cain, after killing Abel, went east from Eden, and dwelt in the land of Nod, and probably in the fertile valleys of the Euphrates and Tigris, himself and his posterity continued the laborious life of tilling the soil, while that part of Adam's posterity that inhabited the hilly country east of the Mediterranean, naturally adapted to grazing, became owners of flocks and herds, and led a comparatively easy, pastoral life.

The record of these early ages is brief in the extreme, the history of two thousand years from the creation to the flood, being condensed in the first six chapters of Genesis. Progress must have been slow, for necessity, the mother of invention, could not have stimulated men to the exercise of much genius or enterprise. The wants of the race in that temperate and fertile region, where by common consent our first parents had their original abode, must have been few. The shepherds and herdmen were probably migratory, driving their flocks and herds from one place to another, as the grazing was consumed.

It is only when population is increased, and men live in villages and cities, that the artificial wants multiply and industry is stimulated. As we sit down to our tables, loaded with products brought from the four quarters of the earth, our families clothed with vesture brought from places thousands of miles remote, our houses furnished with cabinet-work made from wood grown in the tropics, it is scarcely possible to conceive of the simplicity of the mode of living of the antediluvians. They must have invented some method of weaving, for we read of their having tents, and Tubal Cain is spoken of as instructor of every artificer in brass and iron; and they also made some proficiency in music, for Jubal is mentioned as the father of all such as handle the harp and organ.

Though the curse had gone forth, "In the sweat of thy face shalt thou eat bread," it is not reasonable to suppose that much exertion was put forth in the culture of the soil, when the spontaneous fruits supplied most of the wants of man, and a savory mess of pottage was so easily obtained by killing a lamb or kid. The character of man must have greatly altered if he worked for the mere love of work, with no necessity compelling him.

After the flood we read that "Noah became a husbandman and planted a vineyard." This looks like having a permanent home and making improvements. From the skill displayed in building the ark, we might suppose that Noah had a sufficient knowledge of tools and architecture to build himself a house, but he is spoken of after the flood as still dwelling in a tent. We are aware that some interpret the word tent to mean a covering, a protection, but whether made of cloth, or boards, or branches, it was manifestly a movable affair, for it was pitched and moved as the demands of the flocks and herds required.

The patriarchs also dwelt in tents, and their property consisted mainly in cattle, though the precious metals now began to be used as a representative of value and a medium of exchange. Abraham is spoken of in the thirteenth chapter of Genesis as rich in cattle, in silver and in gold; and his nephew, Lot, who was at this time associated with him, had flocks and herds and tents.

Their cattle increased so rapidly that the land of Bethel was not able to support them together, and a contention arose between their herdmen; whereupon Abraham, like a man of peace, said to Lot, "Let there be no strife between me and thee, and between my herdmen and thy herdmen. Is not the whole land before thee? If thou wilt take the left hand, then I will go to the right, or if thou depart to the right hand, then I will go to the left." Lot chose the well watered plain of Jordan, and Abraham remained in the hilly region of Canaan. Land at this time seems to have been as plenty as it is now in our western territories, and every man voted himself a farm and squatted upon it, as the modern phrase is, or in Bible language, pitched his tent where he pleased. It is worthy of remark that the dwellers in the rich, low country, became also low in morals, while those inhabiting the highlands and breathing a purer air were more pure in character. Sodom and the cities of the plain were destroyed, while Hebron remains to this day.

Egypt, called in Scripture "the garden of the Lord," and yearly enriched by the overflowing of the Nile, early attracted the attention of the tillers of the soil. This country furnished a refuge from the terrible drouths which dried up the pastures of western Asia. Abraham himself fled thither with his beautiful wife, and his sheep and oxen and camels, his men-servants and maid-servants, to avoid the famine which was scourging the land of Bethel where he then dwelt.

As population centered on the banks of the Nile, agriculture rose in importance, but the progress was still slow. The change from the state of nature, and from a wandering pastoral life, must have been the work of ages. The nutritious qualities of the cereals, wheat, barley, etc., were a long time in being discovered, and when known, these grains were cultivated in the rudest manner. They were sown on the rich deposit of mud made by the annual overflow of the river, and the only harrowing they received was done by a herd of swine trampling the seed into the ground. In Egypt, too, animal power was first applied to agriculture, but the plow, as delineated among the hieroglyphics on the ancient tombs, was an instrument much resembling our common picks. Abraham's sojourn in Egypt was short, but he remained long enough to learn the improved methods of culture, and possibly indulged in the propensity of his nation to make good bargains, for it is when he came out of Egypt that he is spoken of as having so much silver and gold. Very possibly he exchanged some of his cattle with Pharaoh for these more compact representatives of value, and went back to Bethel to rear more of the same sort.

We may here say that the rearing of cattle appears in all ages to have been one of the most profitable branches of farming. There is sometimes a great temptation to sell the products of the land, without passing them through the grinders of sheep and cattle, and thus converting them into wool, milk and beef. The former makes quick returns, the latter more slow but more sure and remunerative. It is often said that the crops of the farmer are growing when he is asleep, but if he feeds them to his stock there is a double growth, the growth of the cattle in addition to that of the crops. It may be difficult sometimes to calculate how the hay and grain fed to stock is to be returned in its equivalent of money, but the testimony of all history, and all modern statistics, is in favor of the stock farm. In Abraham's day probably no use was made of the manure, for the cereals were cultivated for ages without an idea of increasing the natural fertility of the soil by artificial means, and the sowing of grass seed and enrichment of grass lands is so modern as almost to be within the memory of the oldest inhabitant. But notwithstanding the neglect of what is now considered one of the greatest sources of profit on a stock farm, Abraham became rich by keeping flocks and herds, and with few exceptions all who have followed in Abraham's footsteps have been blessed with similar prosperity.

From Egypt, agriculture as well as letters migrated to Greece. Here, in a soil by no means as congenial as that of Egypt, agriculture rose to a degree of perfection hitherto unknown, and here agricultural literature makes its first appearance. Hesiod, who lived a thousand years before Christ, in his homely poem, "Works and Days," gives a detailed description of a plow consisting of a beam, share and handles. It must have been a clumsy, unwieldy instrument, for he recommends that the plowman be forty years old before he undertakes to handle it.

> "Let a good plowman yeared to forty, drive,
> And see the careful husbandman be fed
> With plenteous morsels, and of wholesome bread."

From the allusions in the immortal Odyssey of Homer, we learn that the Greeks of his day had large quantities of cattle, horses, sheep and swine. Hecatombs of oxen were sacrificed to the gods, requiring a hundred altars and a hundred priests, only one bullock being sacrificed at one altar. In the description of the garden of Alcinous, we find nearly all the luxuries and elegance of modern horticulture:

> "Four acres was the allotted space of ground,
> Fenced with a green enclosure all around,
> Tall thriving trees confined the fruitful mold,
> The reddening apple ripens here to gold,
> Here the blue fig with luscious juice o'erflows,
> With deeper red the full pomegranate glows,
> The branch here bends beneath the weighty pear,
> And verdant olives flourish round the year.
> The balmy spirit of the western gale
> Eternal breathes on fruits untaught to fail,
> Each dropping pear a following pear supplies,
> On apples apples, figs on figs arise.
> The same mild season gives the bloom to blow,
> The buds to harden and the fruits to grow.

Here ordered vines in equal ranks appear
With all th' united labors of the year;
Some to unload the fertile branches run,
Some dry the blackening clusters in the sun;
Others to tread the liquid harvest join;
The groaning presses foam with floods of wine.
Here are the vines in early flowers descried,
Here grapes discolored on the sunny side,
And there in Autumn's richest purple dyed."

This picture is enough to make one's mouth water. With four acres of such tillage ground, we should be ready to subscribe to the maxim, "Four Acres Enough." Granted that the poet draws on his imagination, and combines, as does a painter, different sketches into one grand picture, still the originals must have existed, though in detached places, for a poet "can not make something from nothing," any more than can the farmer. He could not have described the reddening apple, the blue fig, and the blackening clusters of the grapes, without having seen or heard of them, and the description fully proves an advanced stage of horticulture in Greece centuries before the Christian era.

The proof of the advanced stage of Grecian agriculture does not rest solely upon a poetical foundation. Xenophon was a farmer, as well as warrior and historian, and had his country seat on the western slope of the mountains of Arcadia, looking towards the Ionian sea, where he wrote his celebrated "Anabasis," giving the story of the retreat of the ten thousand Greeks, whom after the death of Cyrus, he commanded in their wanderings among the mountains of Armenia. There also he wrote his treatise on horses, and his economics, giving nice details of the management of the flocks, lands, servants and the household. If Bacon burned the economics of Xenophon, he deserves to have most foolish, added to the well known epithets, "wisest, greatest, meanest of mankind."

There is no question but that in the palmy days of Greece, agriculture attained a high degree of perfection. Fine breeds of cattle and horses were raised and extensive importations were made to improve the native stock. The use of manures was also well understood, which Pliny says was first taught by the old king Augeas. The compost heap was skilfully cared for, and everything added to it which could contribute to the fertility of the soil. Drainage was understood and practised, and the swamps and marshes around Sparta were drained and rendered tillable. Farm tools were greatly improved, and the land was thoroughly ploughed, and even subsoiled by the aid of mules and oxen. The Greek farmers also enjoyed the luxury of fruits, and had apples, pears, quinces, cherries, plums, peaches, nectarines and figs. With good culture of the soil, good houses became also a necessity, and rural architecture was carried to a high degree of perfection, though their architects devoted their highest skill to the construction of temples and public buildings. For the encouragement of New Englanders, we may add that the Greeks made all these advances in agriculture on a soil by no means favorable to agricultural pursuits. Much of the land was hard and rocky, and much tillable soil was reclaimed from the swamps. The Greeks as a nation were not fond of rural life. They preferred the city and belles-lettres, and left the cultivation of the soil mainly in the hands of slaves and hirelings. The country did not furnish enough sociability for the lively and sparkling Greeks, who wished to assemble in the market-place daily and hear and tell some new thing.

CHAPTER VII.

RISE AND PROGRESS OF THE ART.—(CONTINUED.)

WESTWARD the march of empire and the march of argriculture took their way to Italy. The culture of the soil was a fundamental idea in Roman civilization. Seven acres of land were allotted by the State to each citizen, and in the early years of Rome no man was allowed to own more than this. The orator Curius says, "He was not to be counted a good citizen, but rather a dangerous man to the State, who could not content himself with seven acres of land." This assignment of land to each individual, and limitation of the amount, led to careful cultivation, as each was expected to earn his living from the soil. Trading was never a characteristic of the Romans, and a merchant was ever considered by them inferior to a farmer. The Greeks talked about appropriating to themselves the things of others in the way of a good bargain, and their subtle genius made them astute merchants. The Romans did indeed appropriate to themselves the things of others, but they did it by conquest. Pious Æneas, as Virgil calls the founder of the Roman empire, took possession of Italy *vi et armis*, and his posterity took possession of the rest of the world in the same manner. As the territory of the empire was extended, the right of freehold to each individual was increased to fifty acres, and still later to five hundred, but as in Germany every man was once expected to learn a trade, so in Rome every citizen was expected to be a farmer, and Pliny ascribed the exceeding fertility of Italy to the fact that "The earth took delight in being tilled by the hands of men crowned with laurels and decorated with triumphal honors."

A Roman coveted, next to the honors of war, the honor of being a good husbandman. Distinguished generals and private soldiers, statesmen and citizens, the learned and the unlettered, alike prided themselves on their skill in agriculture. Cato, the wise censor, eloquent orator and able general, wrote a treatise on agriculture. Cato's summary of the art of terraculture can not be excelled by the president of any modern agricultural college. He says: "The first thing is to plow thoroughly, the second to plow, the third to manure, the fourth to choose good seeds and plenty of them, the fifth to root out all weeds." Neither Lord Bacon nor Horace Greeley ever uttered more practical truth for farmers in less space. They are the grand principles on which successful agriculture ever has rested and will ever rest. Science may explain these principles, but will never annul them. Cato not only understood the value of the plow, but insisted upon a thorough pulverization of the soil by the harrow. He also knew the necessity of drainage and recommended plowing wet land so as to throw it into ridges with deep furrows between them to carry off the water. If William Bender or George Jackson had once explained to the old Roman senator the use of drain tile, his farm would not have been deformed with the unsightly ridges, nor the wasteful open ditches. Cato, like most of his nation, advocated small farms and thorough tillage. Much labor is in the large estate, much profit is in the small.

So highly was agricultural literature prized at Rome that the Senate ordered the twenty-eight books of Mago, the most voluminous writer on agriculture in Carthage, to be translated into Latin for the benefit of Roman farmers. Roman writers on this subject were also numerous, and were esteemed good authority. Among the most distinguished of these was Columella, who lived two hundred years after Cato, and being a man of wealth, traveled through Italy, noticing the condition of the soil and the different modes of culture, and afterward extended his researches into Greece, whence the Romans were accustomed to draw their finest models of art. Columella also traveled westward into Gaul, that he might perfect himself in the art of agriculture, and on his return wrote the fullest treatise on this subject that has come down to us from the old Romans. It is not a little singular that he opens his essay with a lamentation upon the degeneracy of his age, and a sigh for the good old times, when every man owned a little land which he cultivated, like Cincinnatus, with his own hands.

Rome had now become rich and the landed estates large, and these were necessarily cultivated, mostly by bondmen, but we have no doubt that the Romans of Columella's day were as noble as that great brigand, the "pious Æneas," and the cultivation of the soil far better than when the farmers held the plow with one hand and the sword with the other, and were half farmers and half freebooters. Columella gave much advice that is as applicable in New England in this nineteenth century as in Italy in the days of Tiberius. He says, "Whoever would devote himself to the pursuit of agriculture must summon to his aid prudence in business, a faculty of spending, and a determination to work." Our New England farmers have shown great determination in working, but the "faculty of spending" upon their farms the avails of their surplus products has not been overtasked. Fortunately for Roman farmers there were no banks, nor railroad stocks, to tempt them to make investments outside of the business which they best understood.

A manufacturer is very apt with his profits to enlarge his establishment and increase his product. A merchant also, as his capital doubles, doubles his business. But New England farmers have not generally acted on this principle. "The faculty of spending" has not been sufficiently developed. The revenue from surplus products has not been devoted to the improvement of the farm, but loaned to the manufacturer either directly or through the banks. To such we commend this precept of Columella. History abundantly teaches that property is nowhere so safe, nor so judiciously managed, as when under the eye of its owner.

From Columella's account of a Roman farm establishment we conclude the seven-acre arrangement was outgrown in his day. He divides the farm buildings into three classes, the villa urbana, the villa rustica, and the fructuaria; that is, the mansion house, the laborers' cottages, and the barns and fruit houses. The details of these buildings show an age of great wealth and luxury among the rural classes. The mansion house is a large, square building constructed around an inner court with two complete suites of apartments, the one on the sunny side designed for winter, the other for summer. The drawing-rooms, dining-rooms, bathing-rooms, library, and servants' apartments are all on a scale of magnificence which no seven or fifty acres, however highly cultivated, could support. If all the Roman farmers lived in this style, it must have been the Augustan age of farming. We very much doubt, however, whether the farmers of Columella's time, notwithstanding the magnificence of their establishments, enjoyed one-half of the home comforts with which the farmers of New England are now blessed. Their dinners, with peacocks as the most fashionable viand, may have been more stately, but if we could put back one of our farmers to the age of Augustus, and let him spend a year on a Roman farm, he would return contentedly to our present modes of living and farming, and thank the Lord that he did not live "in the good old times."

The old Roman plow which is still in use in parts of Italy and Spain was such an unwieldy, inefficient instrument that it required three days to break up an acre of ground, and when the work was completed, a modern farmer would say that the soil was literally broken up, not plowed. The wheat, rye and barley which the Italians raised, were all pounded into flour in a mortar. A water-wheel for mechanical purposes was not known till one hundred years after Christ, and the winds swept over Europe till the eleventh century without lending any aid to man in grinding his breadstuffs.

The Romans, with all their advance in agriculture, made little use of cattle except for work and milk, and sheep were raised solely with a reference to their wool. Poultry and fish constituted their leading viands. It remained for the English to discover the virtues of sirloin steak and a fat saddle of mutton. Italy had far greater facilities for the advancement of agriculture than Greece. The soil was naturally fertile, agriculture was the honorable employment, and she had all the experience of Egypt and Greece to enlighten her in the art. We must give her great credit for making the progress she did, but there were some things in the very organization of Roman society which prevented the art from reaching its highest development. The farmer received little aid from the merchant. Commerce was looked upon with contempt, and the merchant was treated as belonging to an inferior caste. Mechanics also received but little encouragement from the State, the mechanic arts consequently languished, and hence there was little co-operation of labor. Another lesson from history is that agriculture can not rise to its highest perfection without the aid of commerce, manufactures and the mechanic arts. They support each other as do the trees of the forest, and any jealousy between them is foolish and suicidal.

Another impediment to the advance of agriculture in Italy, was the want of general intelligence. The patricians and nobles were highly educated, but the plebeians were kept in ignorance. The masses toiled on without knowledge or hope, serving the nobility and amassing property for the few to whom wealth brought luxury, and that extreme refinement known by the ungallant term, "effeminacy." The tillage of the soil was left more and more in the hands of menial slaves, till in the fifth century, when the vast tide of barbarians from the north swept over Italy and indeed the whole of southern Europe, bringing on the long night of the middle ages, when might made right, and all kinds of property, and especially the products of the farm, as most exposed, were insecure.

CHAPTER VIII.

A NIGHT OF DARKNESS AND THE MORNING BREAKING.

THIS long night continued from the fifth to the sixteenth century, and scarcely a gleam of light in the form of improved culture is cast upon this period. Around the monasteries the rights of property were still respected, and here literature and agriculture maintained a feeble existence. It is customary to ridicule the monks, and to speak of their lives as barren as the dead trees upon our mountains, but to them are we indebted for the transmission of the literature and art of the old civilization, and ingrafting them upon the more vitalized stock of modern times. To their libraries we owe much of our knowledge of the nations of antiquity, and are even indebted to them for the preservation of the sacred Scriptures; and around the monasteries were found the only remnants of Roman agriculture. The monks had their failings but they kept up the form of Christianity, and a degree of civilization which was vastly superior to anything around them.

The Saracens also, in Spain, successfully resisted the Vandal hordes from the North, and coming as they did from Egypt, Syria, and Persia, where agriculture was carried on mainly by irrigation, they introduced into the Iberian peninsula this system of culture, and built reservoirs and aqueducts, the remains of which are to be seen to this day. To these improvements in her agriculture, introduced by the Moors, Spain is indebted for the foundation of that wealth and power which made her at one time the first State in Europe. "Alas how is the mighty fallen!" The contrast between the agriculture of the Spaniard of the present day, with that under those heathen dogs, the Saracens, does not speak well for modern civilization. We trust the dawn of a better day is now rising upon Spain, and that this country, one of the finest for agricultural purposes on the face of the earth, will again take her proper rank among the nations, and contribute her share to the multiplied wants of modern civilized life.

In passing from the agriculture of Eastern to Western Europe, and from the old to the modern type of agriculture, we ought to give the Romans the credit of extending the arts, wherever they extended their conquests. They came, saw, conquered, but did not devastate. On the contrary they built up. They introduced their laws indeed, and established their form of government, with a procurator to exact tribute, but they were wise enough to know that the conquered nation could not pay large taxes unless the soil was well cultivated, and one of the first objects of the provincial governor was to instruct his subjects in the art of agriculture. During the first four centuries of the Christian era, the Romans had possession of Britain, and though the possession was maintained by an almost constant struggle of arms, still they made improvements in the agriculture of the island from which we are yet reaping the benefit.

When the Roman power fell and the Saxons invaded England, a great check was given to its agriculture. We are fond of boasting of our descent from the Anglo-Saxons, but we must confess a faithful picture of our ancestors is not very flattering to our pride. The Saxons were a rude people, subsisting mainly by the chase and by keeping large numbers of cattle, sheep and swine. The latter were fattened in the forests on the mast of the oak and beech, as but small quantities of grain were raised, not enough to furnish a decent supply of breadstuffs. The character of the food is said by physiologists to determine somewhat the character of the man and the nation. We are inclined to think there is a basis of truth in this, but whether true or not we can not deny that our Saxon ancestors were wild and semi-savage, too much like the beasts they hunted, and on whose flesh they mainly subsisted. No hoed crops and no edible vegetables were raised, and as late as the time of Henry the VIII. salad was brought over from Holland to supply the table of Queen Catharine, who had been accustomed in her childhood to a more civilized diet than England afforded. Neither Indian corn, nor potatoes, nor squashes, nor carrots, nor cabbages, nor turnips were known in England till after the beginning of the sixteenth century. The suffering among the people was often intense. The shelters for man and beast were of the rudest kind, and it was estimated that one-fifth of the cattle perished each winter for the want of proper food and care.

The landlords usually had an abundance of meat, but the tenants subsisted for the most part on barley, from which they made a coarse bread, grinding the grain in small hand-mills.

For the benefit of the admirers of the good old times, we quote from the Treasury of Ancient and Modern Times, the bill of fare for the dinner of an English gentleman, on a feast day in the fourteenth century: "The meat served on the tables was always in great chargers. First course; gammon of bacon, neat's tongue salted, boiled beef, mutton and veal, all larded, sometimes with unsavory lard. After the guests had gorged themselves on these gross meats, then the second course of ducks, pigeons, partridges, woodcocks, and quails, but this second course was partaken of daintily, for the stomachs of the good men were previously filled with the meats."

The condition of the peasantry was miserable in the extreme. They seemingly had no rights which the landlords were bound to respect. If an estate was sold the tenants were obliged to give up all, even their standing crops, without compensation. With such an uncertain tenure of property, agriculture could not be expected to flourish. So late as 1745, Marshal Noailler remarked to the king of France, "The misery of the mass of the people is indescribable," and the remark was as applicable to England as to France. The feudal system gave some little protection to persons and property against petty feuds and depredations among neighbors, but it was too much like the protection that cats give to mice. The ignorant and tyrannical lords protected the peasantry much as they protected their cattle and horses, and for the same selfish reasons.

From this gloomy picture we turn with pleasure to the rise of modern agricultural science and art. The darkness of the middle ages was not suddenly dispelled. The light of knowledge never rises full-orbed in the soul. When God created the earth, and while darkness was still upon the face of the deep, He said, "Let there be light, and there was light." Not so with the light of knowledge. It is always preceded by a long dawning. The discovery of the art of printing in the fourteenth century aroused a general intellectual vigor and stimulated a spirit of inquiry in every branch of knowledge. The discovery of the new world also awakened enterprise, and lifted the wheels of progress out of the slough in which they had been so long sunk.

It is difficult to fix upon the precise time when the light of science first shone with a full orb on the earth, nay, this time has not yet come. Gross darkness does not now cover the people, but prejudice, ignorance and superstition still partially blind the eyes of us all, and it can not be said that the sun of science has yet risen. It is customary to point to Lord Bacon as the corner-stone of modern science, but Bacon's intellect would never have been developed had not the printing-press lent him its aid. Sir Anthony Fitzherbert in 1534, published the first work on agriculture in England. His work is styled "The Boke of Husbandrie," and is a strange medley of agriculture and theology; as he has one chapter "On Buying Lean Cattell" and another on "What Joyes and Pleasures are in Heaven." Nevertheless he gives some good precepts. As a specimen we quote the following:

"A housbande"—this was the Saxon term for our modern husbandman—"can not thryve by his corne without cattell, nor by his cattell without corne, and shepe, in myne opinion, is the most profitablest cattell that any man can have." This book closes in this quaint style: "Thus endeth the ryghte profytable Boke of Husbandrie, compyled by Master Fitzherbandrie, of charitee and good zele that he have to the weale of this most noble realm, after he had exercised husbandrye with greate experience forty years." Thomas Tusser, in the middle of the sixteenth century, published a volume called, "Five hundred Points of Good Husbandry," which had a great run, many editions being called for. Among so many points it would be strange if there were not some good ones. Some of his maxims had great influence, and are quoted by the farmers of the present day, as the following:

> "Who slacketh his tillage a carter to be,
> For groat got abroad, at home shall lose three."

Many agricultural writers appeared, and many improvements in culture were made, during the last half of the seventeenth century, but it was left to Jethro Tull, in the early part of the eighteenth century, to make the first long stride both in the science and the art. Tull was a thinker and a worker. He investigated the principles of fertility, and invented some new machinery to expedite the labors of the farm. "Thorough tillage" was his great panacea for all the ills the land is heir to, and to carry the idea of tillage into practice he invented a horse-hoe and the grain-drill. He also invented the threshing-machine, an instrument of the greatest value, but the English superstition was so much opposed to it as an engine of the devil, that the flail and fan continued in use till the commencement of the present century. The flail is not yet obsolete, but the fan has been seen by few of the present generation of farmers.

Tull was an enthusiast, as most reformers are, and doubtless carried his idea of thorough tillage too far when he stoutly maintained that it would supply the lack of manure. Tull could write and talk as well as work and invent, and his will was so strong and his bump of combativeness so large that he was determined to thrust his ideas into the heads of the English, whether they wished to receive them or not. Of course his new notions met with great opposition, and as there was some error mixed up with his truth, both were received with great distrust.

If Tull had not made the great mistake of rejecting the aid of manure, his theory of the thorough pulverization of the soil, and his improved agricultural implements, would have been adopted at a much earlier day.

What Tull did for the benefit of the culture of the soil, Bakewell did in the improvement of the herds of cattle and sheep. He studied the laws of breeding patiently and intelligently, and laid the foundation for the present thorough-breds of England, which confessedly stand at the head of the herds and flocks of the world, though we expect to see still better in America.

To Arthur Young, who died in 1820, the world is indebted more than to any other man for the advancement of the modern science of agriculture. He visited different parts of Europe to study his favorite art, and made many experiments to ascertain the causes of fertility. To him we are indebted for ascertaining the value of ammonia, which, previous to his time, had been thought to be injurious to vegetation. Young tried it on various soils and various crops, and found it in every trial to succeed. We now look upon ammonia as the test of value for most manures.

Young also experimented with summer fallows, and came to the conclusion that covering the soil is more beneficial than naked fallow, and that a rotation of crops is all the rest the land needs, a conclusion which has added millions to the wealth of England and America. Young drew from his experiments the important principle that nitrogenous manures increase the power of plants to avail themselves of the mineral resources of the soil, thus establishing the necessity for the use of both these classes of manure, a principle fully corroborated by all experimenters since his day. By him, also, salt was first introduced into England as a manure. Young embodied the results of his investigations in a comprehensive work called the "Annals of Agriculture."

As early as 1786, Young says: "To imagine that we are ever to see agriculture rest on a scientific basis, regulated by just and accurately drawn principles, without the chemical qualities of soils and manures being understood, is a childish supposition."

Young lived long enough to see the first chemist of his age, Sir Humphrey Davy, devoting his splendid talents to this fundamental art. At the request of the English board of agriculture, established in 1793, Davy was induced to investigate the elements of soil and manure, and his lectures before the board, delivered from 1802 to 1812, mark an important era in the history of the art. The substance of those lectures was embodied in his "Elements of Agriculture," published in 1813. In this work Davy explains the functions of the roots and leaves, and the construction of plants, showing that they consist mainly of carbon, hydrogen, oxygen and nitrogen, and that these elements are mainly derived from the air, only a small portion of the plant being formed from the materials of the soil. He also gives the analysis of soils, plants and manures, and their special adaptation to each other.

Davy worked, not only in the laboratory, but his zeal for agriculture led him to the practical tests of his theories in the field. We find him in 1805 experimenting with guano, which Baron Humboldt had discovered in the islands of the Pacific. He first recommended the use of bones for manure, which have since played so important a part in English agriculture. What Davy and Johnston did for agriculture in England, Liebig has done in Germany. Neither have the French chemists been idle. Bonaparte, with his enlarged views, did not overlook the importance of agriculture for developing the resources of *la belle France*, and established professorships and botanical gardens, which co-operated in advancing the science and elevating the art.

Our own country has been slow in adopting all the theories of the European savans, but their works, especially those of Liebig and Johnston, have been extensively circulated in America. Our geologists, chemists and botanists have also added their quota to the stock of science, while our practical agriculturists and mechanics have brought their wits to bear upon the advancement of the art. Especially in the department of farm implements we are leading the world. Our plows, mowing-machines, reapers and tedders confessedly stood at the head at the late Paris exposition of the industry of the earth. Land is so cheap here and labor is so dear that we are compelled to give our attention to the invention of labor-saving machinery. In cattle and sheep breeding we also compare favorably with the Old World. No better Durhams can now be found in England than in Massachusetts, New York and Kentucky, and the Vermont merinos have taken the premium at the world's fair. Our State and county societies and our State boards of agriculture are diffusing information among the farmers and stimulating them to excellence in their art, and now agricultural colleges are springing into existence, in which science and practice co-operate to lead on to still further triumphs.

What mind can comprehend the future of American agriculture? In no country and in no age have circumstances been so favorable for the development of this art. Land is abundant and fertile. The working classes are intelligent. The facilities for transportation are unrivaled.

Property is everywhere protected. Commerce, manufactures and the mechanic arts are all co-operative with agriculture. Labor is esteemed honorable, and is so aided by machinery that it is safe to say a man can accomplish twice as much upon the land now as he could at the beginning of the present century. He can rake ten acres now where he could one then, thresh ten times as much grain, plow more thoroughly with less expense of power, and, above all, can feel that while he is doing his work by machinery, he is not a mere tool himself, but a thinking being, guiding inert matter with an intelligent mind. The facilities for transportation are so great that produce can be carried from St. Louis to Boston in less time and at less expense than formerly from Rochester, and the citizens of Massachusetts enjoy the early fruits and vegetables of South Carolina only a few days later than the inhabitants of the Palmetto State. Science is overcoming the obstacles to production in our rigorous climate, and Massachusetts is already driving a thriving trade in furnishing winter flowers and vegetables for New York city. Farmers have but to be true to themselves and their country, and they will be esteemed as the noblemen of the land, and the United States will rank as the first agricultural country of the earth.

LECTURE THIRD.

CHAPTER IX.

THE SOIL—ITS ORIGIN AND NATURE.

AS we look over the face of nature we see an infinite variety. Here vast piles of rocks rise into the air, miles above the level of the sea, covered to a certain hight with loam on which grow tall forest trees, still farther up with a scantier soil and trees of a dwarfish size, till the pines which at a lower elevation attained an altitude of one hundred and fifty or two hundred feet, rise in their maturity only a foot or two, and finally the mountain domes are constructed of the solid rock, with no trees and scarcely any moss, even, to cover their nakedness.

Again we see vast plains, as the prairies of the North, or the steppes of South America, covered with a soil of almost illimitable depth, and supporting a vegetation of rank growth, that waves like a thing of life, as the wind sweeps over the grasses and flowers. In other places, as in our own New England, we find a varied landscape of rugged hills and fertile valleys, the latter most generally covered with frequent and large boulders brought from the mountains, and nowhere having that depth of soil which characterizes the western prairies, and especially the bottom lands, so called, probably because the soil is bottomless, (*lucus a non lucendo.*)

In other places still, as on our Atlantic coast, or the deserts of Africa, we find great plains covered with sharp sand, that supports a stunted vegetation, and sometimes none at all, and is drifted by the winds like snow. The cause of this great variety of surface and the origin of the soils, have ever been subjects of interest to the scholar, and the investigation of them will not be without profit to the farmer, for upon the plants which the soil produces man and all other animals depend for their daily sustenance. Where the soil is fruitful animal life is abundant, and where it is barren as in the desert of Sahara, no plant and consequently no animal can exist.

Thinking men have long agreed in ascribing the origin of the soils to the rocks. The slow disintegration of the rocky crust by attrition and the action of air and water, has given us that more or less pulverized coat of the earth's surface which is fitted for vegetable life and which we call soil. This is a very simple statement and meets with ready assent, but there are problems connected with it which have puzzled the wisest philosophers.

The disintegration, as we now see it progressing, is very slow, and ages upon ages must have elapsed before the present large accumulations could have been made, on the supposition that no other agencies than air and water were in operation. The disintegration of that hard rock, which we call flint or quartz, gives us a sandy soil, but we find vast tracks of silicious sand far removed from all quartz rocks, and the questions very naturally occur—how can these great deposits of sand be derived from so hard a rock, and if so derived, how can they be so far removed from the original source?

The crumbling of limestone gives us a calcareous soil, and the crumbling of slate gives a clay soil, but we find these three leading varieties of soil very generally intermingled and when one variety predominates, it is often remote from its parent rock. This intermingling of clay, sand and lime is essential to a high state of fertility. How has it been so thoroughly accomplished?

Again, we find mixed with these mineral elements, various proportions of organic or vegetable matter, which is also essential to fertility. Whence comes this vegetable mold? These are all questions of interest, not only to the scholar, but to the practical farmer. In purchasing a farm, it is of the utmost importance that we should know the character of the soil, the mineral elements of which it is composed, the proportion of carbonaceous matter in it, and the crops for which it is best adapted, for it is far more economical as a general rule, to locate on naturally fertile land, than to remedy the deficiencies of barren soil. But we can not always select just the location and soil we could desire. Our fathers may have selected for us, or circumstances may render it necessary for us to till an unproductive field. We can not all live in the fertile valley of the Connecticut. Some of us are doomed to subdue the stiff clays of the hills, or to get our living as best we can from the barren sandy plains.

On the same farm, also, we often find a variety of soil; some fields of rich loam, where the clay, sand, lime, and vegetable mold are mixed in due proportion, others where clay is in excess, others where sand or gravel is too abundant, and others still where the deposit of pure vegetable matter, or muck, as we call it, extends down for several feet, and the mineral elements are so deficient that no grain crops can be raised upon them. In these cases we

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want to know how to remedy all deficiencies, and to do it not empirically, as the quack doctor uses medicine, but with a knowledge of the composition and virtues of the different soils. To understand the nature of soils, we must know something of the rocks from which they are derived.

If we examine carefully the rocks of a country like ours, this difference in their physical structure will first strike us. Some consist of one vast mass, apparently melted together like lead, possibly with cracks or seams here and there, and sometimes with a different species of rock running through these seams, but exhibiting no distinct layers or parts. Others consist clearly of separate portions, or strata, lying on each other like flag-stones. This difference makes the great division of rocks into stratified and unstratified.

The stratified rocks cover the largest portion of the earth's surface. The strata are not always, nor even generally, horizontal. They dip, or incline at various angles, and the lime, sand and clay rocks, of which the stratified division is composed, often crop out on the surface of the earth near each other. Where this is the case, the soil produced from their disintegration is naturally richer than when produced from one variety. Many rocks also consist of a mixture of lime, sand and clay, and the crumbling of these produces those fertile loams which farmers love to cultivate.

The unstratified rocks also consist of three varieties, the granites, traps and lavas, which in like manner crumble and produce soils; the granite a cold, poor one, the trap a fertile, and the lavas a remarkably fertile soil. In New England our skill is often exerted upon a poor, granite soil, but the valley of the Connecticut is blessed with trap, while Italy, Sicily, the Sandwich Islands, and every other volcanic country, exhibit the astonishing fertility of crumbling lava.

If we examine the rocks more carefully, we shall find abundant evidence that they have once been in a fluid state. Far back in the ages the earth has once been melted with fervent heat. The curved appearance of the veins in the rocks show this. One variety of rock running up through the seams of another variety also shows this. The cooling of this heated mass produced those inequalities upon the earth's surface which we call mountains and valleys, just as the cooling of melted lead produces inequalities upon its surface. The cooling process is still slowly going on, and only the crust of the earth is now solid ; and internally the fires are still raging.

Probably the concave surface of the crust has the same inequality as the external convex surface, the depressions and elevations of the concave corresponding with those of the convex. Certain it is that whenever the internal fires burst forth, as in volcanoes, they always find vent at the tops of the mountains, and not in the valleys, as they naturally would if the crust of the earth is thinnest there. But on the supposition that the molten lava rises to a higher elevation under the mountains, we can easily account for its finding vent at their summits, for here the resistance to it is less than under the valley, where the depression externally makes a corresponding strong arched concave internally.

The inquiry naturally arises,—where was the water when the earth was all in this molten state? It certainly could not have existed in the form of water till the heat was reduced below two hundred and twelve degrees Fahrenheit. But it is not impossible that it may have existed in the regions of space (or the firmament, as the Bible calls it,) and both the water and the air must have been expanded to a great extent.

This idea is not inconsistent with the Mosaic account, "And God said let there be a firmament in the midst of the waters, and let it divide the waters from the waters. And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament. And God called the firmament heaven." The records of nature and the records of the Bible are made by one God, and he is a God of truth, and truth is always consistent with itself. These records help to interpret each other, and when rightly interpreted all apparent discrepancies will vanish.

Much needless anxiety has been felt by theologians, lest the teachings of science should go counter to those of Holy Writ. Truth need not fear the assaults of any foe. God has written the history of the world in indelible characters on its face, and stamped his signet on the rocks just as surely as he has written the history of man and made a fuller revelation of himself in the Bible. He has given us minds to study both these great volumes; let us do it faithfully and candidly, and we shall find new truth and new beauty reflected from one on the other.

In the passage quoted above, the waters are spoken of as above the firmament or heaven, and this is entirely consistent with the idea that the earth was in a molten state, and the waters in the form of vapor. Of course with this amount of vapor in the heavens, darkness must have been upon the face of the earth. "And God said, Let there be light, and there was light," and when He set the greater light to rule the day and the lesser light to rule the night, and made the stars also, and set them in the firmament to give light upon the earth, it is not to be supposed that this was the first creation of these luminaries. As the earth cooled, and the vapors condensed in consequence upon its surface, these greater and lesser lights began to shine.

The Scriptures were not designed to teach science, but the language of the Bible, if rightly interpreted, will not be found to contradict the language of nature, if it also is rightly interpreted. All well informed theologians, as well as geologists, agree in giving to the word "day," in the first chapter of Genesis, the signification of an indefinite period of time; and when it is granted that "a day with the Lord is as a thousand years," geologists have all the time they require to account for the formation of soils and all the other phenomena of the earth's surface. We know, from what we see daily occurring around us, that God does not count time as man counts it. "The mills of the gods grind slowly, but they grind exceeding fine." The soil has been a long time in formation, but there is an abundance of the impalpable powder, and it is exceedingly well adapted for the purposes of vegetation.

CHAPTER X.

THE GLACIAL PERIOD.

OF course, when Pluto gave up the dominion of the earth, Neptune took possession of it. The marks left by his trident are as manifest as those left by Vulcan. As the earth became cool, it necessarily contracted unevenly, as does a baked apple when cooled, and the hard, rocky crust cracked and assumed the various fantastic forms which now appear. Through the fissures of one variety of rock the molten mass of another flowed and then cooled, and thus we see veins of granite and quartz mingled with lime and slate.

A vein of granite, forty feet thick, may be seen projecting up through the mica slate in the Westfield river near Huntington in this State, and as it disintegrates more slowly than the slate, it forms a natural dam and waterfall. Cascades of similar formation may be found in most of our mountain streams. Until recently it has been thought by geologists that the action of frost, air and water upon the rocky crust was sufficient to account for the formation and transposition of the immense mass of matter now existing in the soil. The freightage by water of the huge boulders—those loose rocks which we see lying scattered about the surface of the earth or find imbedded in the soil—has, however, always called for the exercise of great faith in the power of water. Some of them weigh thousands of tons, and have been transported hundreds of miles from their original home in the quarry, high hills furnishing little impediment to their passage.

Dr. Reed has found a boulder in Berkshire measuring fifty feet in length, forty in width, and averaging ten feet thick, and estimated to weigh five million pounds. This boulder was brought from a ledge in Canaan in New York, over high hills. Dr. Reed has traced boulders from this same ledge lying scattered through Richmond, Lenox and Lee, running in a course a little east of south, occupying a space twenty to thirty rods wide at first, but gradually increasing in width as the distance increases, the boulders, however, diminishing in size till they are finally lost sight of, some twenty miles from their starting-place. Similar boulders, in a similar direction, may be tracked from nearly every high ledge of rocks in the country.

We are indebted to Prof. Agassiz for the theory of the glacial period, which satisfactorily accounts for the transportation of these rocks, and also for their being ground into soil. Born among the Alps, and early conversant with the immense fields of ice that now fill the Swiss valleys, he studied the phenomena of the glaciers with the enthusiasm of an ardent lover of nature. He found that they were slowly moving down the valleys, grinding by their immense weight the rocks underneath them, and carrying on their backs and in their fissures boulders that had fallen upon them from the ledges far above. As the glaciers melt at their extremities, these boulders fall to to the ground. Agassiz found that these glaciers had formerly extended much farther down the valleys than at present, and had also left their scratches and grooves at a much higher altitude than their present surface.

Extending his researches in this country, he found the same indications of glaciers here as in Europe. The striæ are distinctly marked on our mountains to the height of 6,000 feet, and at this elevation they all indicate a nearly southward movement of the glacier, the lower hills running east and west offering no obstruction to their motion, any more than do the inequalities in the valleys obstruct the movement of the existing glaciers in Switzerland and the Arctic regions. Hence Prof. Agassiz concludes that the whole of British America and the northern part of the United States have once been covered with immense fields of ice, in this section of the country reaching to the height of six thousand feet, and moving southward, crushing and grinding the rocks, and fitting them for the sustenance of vegetable life.

As the ice melted, the glaciers only occupied the valleys and moved in the direction of the declivity of these valleys, sometimes northward, sometimes eastward, just as the brooks and rivers now run. In proof of this the lower grooves which the glaciers made are found to run in the direction of the declivity of the valleys. Just west of the village of North Adams, where the Hoosac turns to the west in a narrow gorge between the mountains, the grooves on the side of Greylock are distinctly seen running to the south-west, while on the top of the mountain they take the usual southerly direction.

The melting of so much snow and ice must necessarily have caused great floods, and our hills and valleys give every proof that they have been once submerged with water, which acted an important part in fitting this world for the abode of man. By these floods the sand, gravel, clay and lime have been transported and intimately mixed after being ground in the great mills of the glaciers.

Conical hills of gravel and sand have also been thrown up by the eddies of water, just where we might calculate counter currents would make these eddies. As we trace down the courses of a valley through which now runs some river or rivulet, we find the action of water far above the high water mark of the present day. The sides of the hills are terraced, table-lands on whose surface water once flowed, are found hundreds of feet above the level of the rivers, the small stones having all their angles worn off, and their surfaces showing the smooth rounded appearance which the stones on the sea-beach present from their constant attrition against each other by the movement of water.

We see, also, the barriers of mountains through which the rivers have broken, gradually deepening their channel with the lapse of time. Behind these barriers we find every indication of the waters forming lakes, and depositing in their stagnant state the rich alluvium, composed of the finer powder of all the rocks lying on either side of the valley for a long distance.

Here in the bed of these old lakes we should expect to find the richest soils,—nor are we disappointed. The meadows of Northampton, Hadley, Hatfield, etc., have such an origin. The Connecticut was evidently once dammed by the Holyoke range of mountains, and when the waters lay stretched quietly over where now are the villages of the valley, they deposited their rich mud, brought down from Vermont and New Hampshire, to enrich our Massachusetts territory.

No better soil have we seen between the Atlantic and the Mississippi than is to be found in the Northampton meadows, and he is a fortunate farmer who owns the broad acres in that location.

A similar mountain barrier is found between Lee and Stockbridge, in the Housatonic valley, also west of Stockbridge and south of Sheffield, and in all these cases a rich alluvial deposit is made, forming a fertile soil, though of much less extent than in the Connecticut valley.

This process of transportation and deposition by the rivers is still being carried on, but on a limited scale compared with what it was after the glacial period. With every spring freshet, caused by the melting of the winter's snow and ice, the rivers make an annual deposit of fine soil on the meadows they overflow, which serves to keep them in a state of virgin fertility perpetually. Such lands are cheap at almost any price. They are enriched by the finer and lighter particles of the crumbled rocks from the hills and mountains contiguous to the valley, while the coarser and less easily transported materials are left on the summits and slopes.

The amount of soil now thus transported, though small in comparison with the times posterior to the great grinding glacial period, is still larger than we are apt to suppose. If we should undertake to cart upon our meadows the top dressing which the rivers now furnish them, we should find that we needed a large compost heap, and that the rivers easily perform what we should find it very laborious to do.

The Missouri river is especially rich throughout the year with these fine particles of soil, and a tumbler of the river water, when allowed to stand, shows a large deposit. A Missouri lady, accustomed to drink the turbid water of this river, once objected to the pure limpid water of New England, because it had "no body to it." We should decidedly object to drinking such well-bodied water, but for irrigating land it must be excellent.

CHAPTER XI.

ORGANIC MATTER IN THE SOIL.

WE have thus given a brief and imperfect account of the origin of the inorganic elements of our soils. Besides these mineral elements, every soil capable of producing a profitable crop must contain more or less organic matter. The proportion of organic matter varies greatly. In some of the barren sands only a trace of it can be found, while in the muck swamps it is in such excess, and the mineral elements are so scanty, that no grain crops can be raised upon them.

The proportion of vegetable matter in any soil is easily ascertained by burning it, when the organized portions pass off in the form of gas. If thoroughly dried soil loses 30 per cent. by being burned, then 70 per cent. of it is inorganic and 30 per cent. organic matter. The quantity of the latter necessary to constitute a fertile soil, is much less than is generally supposed. Rye will grow where there is 1 to 2 per cent. of organic matter, barley requires from 2 to 3 and good wheat soils contain from 8 to 12 per cent. Some of our richest lands contain only 6 to 8 per cent. in weight, while the average of our long cultivated fields will not exceed 5 per cent. It does not follow because land abounds with vegetable matter that it must necessarily be fertile. The organic matter of plants as they decompose goes into the air, and from the air the living plant mainly derives its carbon, the leading element in its constitution. The mineral elements of all vegetation, however, must be derived from the soil, and upon these its fertility must largely depend.

When land is plowed, the carbon in the soil, being exposed to the sun and air, diminishes much more rapidly than in the mowing and pasture fields. Hence one argument against the absurd practice of summer fallowing, an old and pretty much obsolete custom of letting land lie idle during one season, and plowing it a number of times during the summer. The theory was that the fallow ground recovered its energies during the one year holiday, and was thus fitted for renewed fertility. The plowing does exert an excellent mechanical effect on the soil, mixing and pulverizing it, and giving it that fine tilth which plants love. The vegetable matter, also, by frequent turnings is exposed to the air, decays rapidly, and by its decay is fitted to give new life to other vegetables, and the crop of the succeeding year is generally good, but it is obtained at an expense of time, labor, and material, which is far from economical. The waste of the vegetable mold by summer fallowing is especially great in warm, sandy lands, that can poorly afford it.

Nature teaches us a better mode. She practices no fallowing, knows no summer holiday. Her effort seems to be to keep the soil constantly covered with some growing crop and to lay by a store of both mineral and vegetable matter against a time of need. When the material in the soil for producing one kind of crop is exhausted or becomes scarce, she rotates to another. Thus we see in our permanent meadows a change of grasses spontaneously going on in a succession of years. This rotation is more manifest still in our forests, where the trees that once grew are known no longer.

In the early settlement of Berkshire county, more than a hundred years since, the white pine was one of the most common of trees, and clear pine boards two and sometimes three feet wide, were used in the ceiling of our fathers' houses. The pines soon disappeared and maples were the leading trees of the forests. Now the maples are disappearing and the pines are springing up in the forests and pastures, and growing with great luxuriance, showing that they find in the soil an abundance of food. This rotation of crops is all the rest the soil demands, if the teachings of nature can be relied upon.

The forests also beautifully illustrate the mode in which nature, or rather the Great Architect of nature, lays up stores of vegetable food in the soil, furnishing an abundance for present need and at the same time laying up for future use. If a barren soil is planted with forest trees, it will soon have a rich deposit of leaf mold, and will continue to improve till it is restored to a state of virgin fertility. The leaves of the trees, with their millions of little pores, absorb the carbonic acid gas of the air, elaborate it with a skill which a chemist may well envy, retain the carbon, and give out the oxygen; thus performing the twofold office of purifying the air and invigorating the tree. As the leaves, the lower branches, and the bark fall to the ground and decay, they form a soil, which, when the forest is cut down, is ready to produce any crop the farmer is pleased to put upon it.

This increase of carbonaceous matter in the forests, under the tillage of the Great Husbandman, is wonderful, and is a strong proof of the wisdom with which he husbands the resources of the earth.

It would seem at first thought that the soil must be enriched at the expense of the air. But in reality, there is no "robbing of Peter to pay Paul." One twenty-five hundredth part of the volume of air is carbonic acid gas, and this proportion is found to remain with slight, if any, change from year to year. The decay of plants and animals, and the combustion of wood and coal, restore the carbon to the air just as fast as plants consume it.

The discovery of the immense coal beds, so long stored away in the bowels of the earth against a time of need, and the increased consumption of fuel in consequence, have led some to fear that the air might become surcharged with carbonic acid, which, though vital to plants, is deadly to animals, but the fear is groundless. As the carbon in the air increases, the absorbing vegetation also increases, and the equilibrium is maintained. Instead of the air being poisoned from the combustion of coal the soil is enriched, and we have no doubt a gradual improvement of the soil, both in mineral and vegetable resources, has been going on from the time when the rocks first began to crumble.

Man's mode of tillage has been careless and wasteful, but God's has been provident and economical. We have plowed the land and taken off the yearly harvests, making poor returns to the soil for the abundant crops it has furnished us. The temptation to do this is particularly great in a new country, where land is cheap and labor is dear. We crop one field till the elements of fertility are exhausted, and then migrate to another.

Old England has passed through the exhausting process, and long years ago began to recuperate, and now her average of wheat to the acre has risen to thirty-six bushels, while the average of New England has fallen to twelve. There is no necessity for such exhaustion. If we study the character of the soil, and imitate nature in restoring the potash, lime, soda and other ingredients which we remove, we shall find it easier to keep the soil in good heart than to renovate it when exhausted, as it is easier to keep an animal in good condition than to bring it up from a state of leanness.

The formation of peat swamps, where the proportion of vegetable matter constitutes from 70 to 90 per cent of the soil, is a subject of interest to the farmer and the student of nature. As the coal fields seem to have been reserved by a kind Providence for this age of manufactures, so the peat swamps appear to have been reserved to renovate the exhausted lands of the farmer, and to supply the increased demand for agricultural products which manufactures cause.

When a plant dies on the surface of dry land, it speedily is decomposed, and the organic part resumes its gaseous condition and vanishes into thin air, leaving only a small residuum of earthy matter, which also soon disappears under the influence of rain and wind. Not so when the plant dies and is immersed in stagnant water. Then it blackens, falls to pieces perhaps, but the carbon mostly remains in a solid state. Other plants grow on the same spot and in like manner die, and the black vegetable matter accumulates, and so long as it is immersed in the water little change is produced in it. Leaves blow into the swamp from the neighboring forest, and are in like manner preserved by the water from the action of that great decomposing agent, the air.

Thus the peat or muck slowly accumulates, till, after the lapse of centuries, we find the deposits of carbonaceous matter some ten, some forty, and even fifty feet thick. Decay of vegetation, we must remember, is only a slow combustion, caused by the chemical union of the oxygen of the air with the carbon of the vegetable. This slow combustion can not take place where water is present in excess, any more than wood can burn when under water, or when saturated with water.

When the water is once driven from the wood it burns; so when the water is drained from our swamps, decay of the muck progresses rapidly, and if a little sand and lime are carted upon them they make some of our best soils. All over New England we find these muck swamps, which were formerly considered worthless, almost a nuisance, as they bred miasm and fevers. We are now beginning to learn their true value. By pressure, the muck is converted into a tolerable substitute for that most condensed form of carbon, used as fuel, anthracite coal. The resemblance of pressed muck to mineral coal is quite striking, and very possibly the coal beds were once muck swamps, pressed by the superincumbent drift, and condensed into their present state.

The condensation would necessarily evolve great heat, on the chemical principle that the capacity of a body for caloric is diminished directly as its bulk is diminished. But however great the heat, the muck could only be charred not burnt, the presence of air being necessary for combustion, and no charcoal pit was ever so effectually protected from the air as are our coal beds, having, as they often do, hundreds of feet of slate and earth piled upon them. Whatever may have been the origin of the coal fields, there can be no doubt of the origin of the muck-beds, for we see the process of their formation still going on; and there can be as little doubt of the kind designs of Providence in storing away these immense deposits of vegetable matter for the use of the farmers of the present day.

The organic matter in soils is not wholly of vegetable origin. The myriads of living animals that walk on the earth, or fly in the air, were originally made of dust, and to dust they must return. Like plants, animals as they decay on the surface of earth leave little trace of their organic constituents; still the soil is a great absorbent of ammoniacal and other gases, and although they may mostly pass into the air when the animal decays unsurrounded by an absorbent, still every rain brings them back to the earth, and we are inclined to think the fertility of a soil is more dependent upon its capacity to absorb these gases than is generally supposed. Charcoal, and indeed all carbonaceous substances, are great absorbents. Charcoal will absorb ninety-five times its own bulk of ammonia, fifty-five of sulphureted hydrogen and nine of oxygen.

We have all noticed that where a charcoal pit has been burned the soil remains good for a long time. On the mountains of Berkshire we have seen white clover growing luxuriantly on the bed of an old charcoal pit, making an oasis in the desert of ferns and briars that surrounded it, and on inquiry we found that the coal pit must have been burned half a century ago. On digging into this soil we discovered the charcoal with little if any appearance of decay, and promising to do good service for half a century more. Dry muck is mostly composed of carbon, and much of its virtue must consist in its power of absorption. A dead animal, covered with a foot or two of muck, does not pollute the air with the gases generated in its decay. All soils have their power of absorption to a greater or less extent, and on this principle the modern earth closets are constructed.

A friable clay loam, containing from 10 to 20 per cent.

of organic matter, is a powerful deodorizer, and the most putrid substance, buried slightly under such a soil, gives forth no offensive odor. The gases thus absorbed by the soil, though destructive to animal life when inhaled through the lungs, are just the food on which plants thrive the most, and a skillful agriculturist looks well to see that his soil is ever ready to absorb the gases that are ever floating in the air and descending to the earth in the dews, snows and rains. An upland meadow, covered in the autumn with any absorbent, whether muck from the swamps, leaf mold from the forests, or the fine alluvial deposit from the side of the brook, will show in the spring that the top dressing has not been idle during the winter, but has absorbed from the rains and snows that which gives the meadow a beautiful coat of green before the neighboring fields show any signs of verdure.

The quantity of the rich ammoniacal gases in any soil it may be difficult to determine theoretically but practically the crops always show where they abound, and much of the skill of the farmer is shown in keeping his land in that dry, loose, friable state which is best adapted for their absorption. A cold, wet, hard soil can not support a luxuriant vegetation, however abundant it may be in vegetable matter, as the air and gases can not penetrate it.

CHAPTER XII.

CHEMICAL ANALYSIS OF THE SOILS.

THE chemical analyses of soils have thus far disappointed somewhat the expectations that a few years since were raised respecting them. The chemist can not always detect the homeopathic quantities that enter into the composition of the soil and effect its fertility, and there are many circumstances that may render a soil fertile or barren that analysis does not disclose; but however complex the composition of a soil may be, viewed scientifically, there is little practical difficulty in ascertaining its general character, and its adaptation to the growth of any particular crop.

Practical farmers classify soils into four general divisions: clay, lime, sand and peat. A gravel soil is included in the sand, for both have the same origin in silex, and sand is merely gravel more finely ground and differs from it only as meal differs from hominy. A perfectly pure specimen of cither of these soils is seldom found, and no farmer wishes to find any for agricultural purposes. The mixture of these four kinds of soil varies as indefinitely as do the mixtures of the druggist. The mixture goes under the general name of loam, but how great a per cent. of clay, sand, lime, and peat it takes to constitute a good rich loam it would puzzle most farmers to decide.

We have noticed that farmers generally prefer the kind of loam which they have been most accustomed to cultivate, just as they prefer the quality of water, they are accustomed to drink. No matter if the water is hard with lime, a man accustomed to drink it thinks it sweet, dislikes the soft water of the mountain spring, and calls it insipid. Just so the farmer brought up on a strong clay loam, and understanding its properties and the mode of cultivating it, pities his neighbor doomed to cultivate a light sandy loam, and the pity is generally returned with interest.

Lord Bacon, who condemned all previous writers on agriculture as loose in their facts and indefinite in their conclusions, says "the mellow earth is the best between the two extremes of sand and clay, if it be not too binding," meaning, probably, if it does not have too much clay in its composition. This is as indefinite as any of the rules of Columella or Fitz Herbert, which the great philosopher thought of so little value as to commit to the flames.

Let not the practical farmer be discouraged because the doctors of agriculture do not agree. The truth is, the fertility of land does not depend upon its having just such a per cent. of clay, sand, lime and vegetable matter. Both practical experience and chemical analysis disclose the fact that soils may vary greatly in their earthy and organic combinations, and still be very fertile. The plant wants a good home in the soil, but it lives mostly on the air. All the mineral nourishment it demands of the soil is what is found in the ash after the plant is burned, and this is a small fraction of the weight of the plant.

A cord of wood that makes a good load for a pair of horses, when burned does not leave ashes enough to burden the back of a small boy. A hundred pounds of the grains of wheat make one and eighteen one-hundredths pounds of ash. A hundred pounds of wheat straw, when burned, leave three and a half pounds of ash. A hundred pounds of potatoes or carrots make less than one pound of ash, while the percentage of earthy matter in clover is only one and one-half. The quantity of inorganic matter furnished to the plant by the soil is thus seen to be exceedingly small, but it does not follow that this small quantity is not of great importance, and they have erred egregiously who have maintained that good tilth was all the land required to keep up its fertility.

Fine pulverization is very important to furnish a good seed-bed, and to enable the rootlets easily to wander in search of food, but some saline food they must find, or they wander in vain. In the ash of plants we find some ten or a dozen inorganic elements, the principal of which are sulphur, phosphorus, potassium, sodium, calcium, aluminium and silicon, which are found in different states of combination, both in the ash and in the soil, but never are they found in the air in such a state that they can enter the plant through the leaves or other superior parts, and must therefore enter by the roots.

However nicely we plow and till the soil, we shall find that in a succession of crops, especially if the same crop is raised on the same ground, though the quantity of earthy matter each crop may require for its sustenance is small, yet the land after a time becomes impoverished, and the crop can no longer be raised with profit. We see, also, from the analysis of plants, that it is not simply clay, sand and lime that plants need to find in the soil, but quite a variety of food. The dainty little roots must have ten or a dozen courses daily, or they complain of being starved. Very little of our tillage land is not furnished with an abundance of clay and sand to supply the demand of the growing crop for alumina and silex. So far as the wants of the plant in its chemical construction are concerned, it matters little whether the clay constitutes 10 or 30 per cent. of the soil, whether sand abounds or is scarce. It is true, however, that clay is a much better absorbent and retainer of the gases than sand, and the general impression that a clay loam makes the richest soil is undoubtedly correct.

The quantity of clay in a good rich loam is, however, generally overestimated. The pure porcelain clays, which are the richest in alumina, contain only from 42 to 48 per cent. of this earth, the balance consisting of silica in the state of an impalpable powder. The strongest clay soils which we cultivate, rarely contain over 35 per cent. of alumina. What we call pure clay consists of a chemical combination of alumina, about forty parts, and silica, about sixty, with sometimes a small per cent. of oxide of iron and a trace of lime. Such a clay of course is unfit for agricultural purposes till more sand and some vegetable matter are incorporated with it.

The chemical composition of the soil is not the only thing the farmer wishes to study in selecting his farm or cultivating his crops. The mechanical effects of clay, sand and vegetable matter are almost as important as their chemical. When clay is in excess, the land is difficult to be worked, cannot be plowed early in the spring, and when plowed is apt to bake into rigid lumps, and it is almost impossible to produce that fine tilth which plants greatly affect. Clay is retentive of moisture as well as of gas, and clay lands are apt to be wet and cold. They are well adapted to grass, and generally it is better, when they are well stocked with grass seed, to let them alone severely; certainly their rest should not often be disturbed by the plow. A top-dressing with compost occasionally, in which muck or sand forms the basis, will keep them in good heart. Indeed, the land and the crop will both improve under this treatment, and grass will be found far more remunerative on a clay soil than corn or potatoes. In the course of years, by the decay of the grass roots, and by the ameliorating influence of the top-dressing, these lands will be found so improved in character that they can be plowed with profit.

Sand is the perfect antipodes of clay in its mechanical structure and effects. Clay is soft and unctuous, sand is hard and scratchy; clay is cold and moist, sand is dry and warm; clay bakes into a compact mass almost as solid as stone, sand is always friable. It is in consequence of its mechanical, not its chemical composition, that sandy loam is so generally preferred for culture by most farmers. It can be plowed early in the spring, worked immediately after a shower, makes a much finer bed for the germination of seeds, allows the roots to permeate as they please, allows air and heat to penetrate to the roots, and does not expand, contract and crack under the influence of heat and moisture.

What we call a pure sand seldom contains less than 5 per cent. of clay, and a sandy loam contains from 60 to 90 per cent. of sand. To ascertain the amount of water, sand, clay and vegetable matter in a loam it is simply necessary to dry the soil thoroughly on a piece of paper in an oven, the heat of which is not sufficient to brown the paper. The loss in this process of drying gives the amount of water. If the loam is now placed on a shovel which is heated to a red heat, the loss will indicate the amount of organic or vegetable matter, and the balance will mainly be sand and clay, and the proportions of these can be ascertained with sufficient accuracy for all practical purposes by boiling in water and allowing the sand to settle to the bottom, which it soon does, leaving the clay in a state of mixture with the water. When this is poured off, the sand can be dried and weighed. The weight of the sand subtracted from that of the sand and clay together gives the weight of the latter. This process gives only the four principal constituents of the soil, and makes no allowance for the lime, soda, magnesia, iron, etc., which must enter more or less into the composition of all fertile soils.

We are inclined to think that full justice has not yet been done to sandy soils. We have looked upon them as barren disfigurements of the earth's surface, scarcely worthy of notice. This is an impeachment of the wisdom of the Creator, who made the sand as well as the clay, and when he had finished his work pronounced it all good.

The sandy plains of Cape Cod, Long Island and New Jersey have been pretty much left in a state of nature to shift for themselves as best they could. If they produced a few stunted pines, we accepted the gift ungratefully and did not ask for more. The experiments made with these sandy plains, within a few years, have resulted very successfully, and encourage us to hope for still further triumphs. Vineland has been made to bud and blossom, if not with roses, certainly with strawberries. If clover can be made to grow upon these pine plains, by means of plaster and ashes, we see no reason why they may not be brought into a high state of fertility with more ease than our fathers have subdued the lands covered with mighty beeches, oaks and maples. The long tap-root of the clover brings up fertility from a great depth, and, as it decays, leaves the fertilizing material within the reach of other plants. These sandy lands, when once fertilized, are easily worked, and for corn, potatoes, small fruits, and early vegetables, are exceedingly well adapted. We also look for good results in the use of sand in the compost heap, and in lieu of litter for cattle. We have tried it sufficiently to know that it keeps the air of stables pure and healthy, and, for a top-dressing of clay lands, we prefer the sand compost to one of muck, as it renders the land dryer, and, consequently, warmer.

We should do injustice to this subject of soils, did we not speak briefly of the subsoil. Beneath the surface soil through which the plow goes, and in which we intrust our seed, often lies another stratum, sometimes of the same mineral character as the surface, sometimes having more sand or clay, but generally quite destitute of vegetable matter. In a mass of loose matter spread over the surface of the earth it is easy to understand how the first few inches should acquire a different chemical and physical character from those immediately beneath, even though originally alike.

On the surface, plants grow and die, and the decayed vegetable matter becomes mingled with the clay and sand, giving the soil a darker hue and a more light and porous nature. On plowed land this mixture is more thoroughly made than on the unbroken prairie or in the forest, and the distinction between the soil and subsoil is more marked. The impression is quite general that the subsoil is worth little or nothing for agricultural purposes. If of the same mineral constitution as the surface soil, then by a little care it can be made just as available for the production of crops. Oftentimes, by plowing up an inch or two of it, the surface soil is rejuvenated, those mineral elements being added which had become in a measure exhausted by long cultivation.

The percolation of water through the earth's surface is continually washing the lime, soda, potash and other soluble salts into the subsoil, so that it often is much richer than it appears to be, and one of the greatest improvements in modern times is the subsoil plow, which brings these salts within the easy reach of plants.

We should not advise bringing too much of the lower stratum to the surface at one time, but would prefer testing an inch or two of it. If found beneficial, more can be added afterwards, and no one will dispute the farmer's right to go as deep as he pleases, for by his title he owns from the surface to the center of the earth, though too many farmers are contented with actually possessing only six or eight inches in depth. If the surface is clay and the subsoil sand, or the reverse, then the mingling of these two can not fail to be beneficial. It may not pay to cart sand upon clay or clay upon sand from any great distance, but when they lie so contiguously that the plow can do the work of mixture, there can be no question of its advantage.

We have thus given briefly the origin of our soils and the different characteristics that they now present. The subject is one of great interest both to the scholar and the farmer. It is emphatically true that we know the physical structure of the earth only in part, but we know enough to lead us to adore Him who in wisdom made this world for the abode of man. Through long periods of time he seems to have been fashioning it for our convenience and comfort. In the oldest rocks, the azoic, there is seen no trace of even the lowest order of animal life. God never works in a hurry. A thousand years are with him but as one day. Gradually the changes on the earth occurred, till finally man was made in the image of his Creator, capable of tilling and subduing the earth and having dominion over every living thing that moveth. This capacity we have not fully exercised, partly from ignorance and partly from indolence. The times of ignorance and sloth God has winked at, but now commandeth every man to study and to practice what he learns. The character and capabilities of the soil which he cultivates should be one of the first objects of the farmer's attention. The Creator has wonderfully adapted the soil for the home and support of vegetation, but in this, as in all his other works, he has left room for the exercise of human skill and industry. He desires that we should share with him the pleasure of improvement, and he has furnished us with ample faculties for making improvement. The peach and the pear did not attain their present lusciousness without the intervention of human skill. The margin for improvement in the soil is great, and whoever so cultivates it that it deteriorates is a robber. He robs Mother Earth of her ability to supply the wants of future generations. What we look back upon with most pleasure in our farm life is, that the land which we inherited from our fathers is now capable of producing fourfold as much as when it came into our possession.

LECTURE FOURTH.

CHAPTER XIII.

FARM DRAINAGE.

THE art of draining the surplus water from land has generally been considered a very modern one, and in one sense it is modern, but the world has ever had a system of drainage in its rivers and rivulets, and our present system is only carrying out more perfectly, or rather more minutely, the great plan of drainage which has ever been in operation since the rivers first began to run into the sea. Both drainage and irrigation, which the scoffers at progress sometimes attempt to ridicule as counter to each other, were in successful co-operation when Adam cultivated Eden, and a river at the same time watered and drained his garden.

Noah and his family must have watched with no little anxiety the subsiding of the waters through those great natural aqueducts, the rivers, for though we read that "God made a wind to pass over the earth and the waters assuaged," still the assuaging does not appear to mean a drying up by means of the wind, but only that the sky was cleared and the waters were checked, for in the six hundredth year of Noah's life, in the second month and the seventeenth day of the month, were all the fountains of the great deep broken up, and the windows of heaven were opened, and though the rain continued only forty days, Noah did not leave the ark till his six hundred and first year, first month, and first day of the month. But though drainage is taught by nature, and they who scoff at it must also scoff at the wisdom of the Great Architect, still artificial drainage was imperfectly practiced by the ancients.

The Egyptians knew full well the advantages of irrigation, and had open ditches to convey water to and from the land; and the Romans had blind ditches, constructed of stone or brush to drain their cultivated fields, and a very perfect system of sewerage for their cities; still the drainage of land was very poorly understood and practiced on a limited scale, till it was introduced into England in the seventeenth and eighteenth centuries. Palladius, a Roman writer, does indeed make mention of earthenware tubes for aqueducts, but they were used simply to convey water from place to place, and not for conveying it from the land.

In 1650, Walter Bligh published "The English Improver Improved," in which he advocated deep drainage as applicable to water meadows and swamps and all other moist lands. In his quaint style he brings out some fundamental truths, mingled with some error. He says, "And for thy drayning, it must be made so deep that it goe to the bottom of the cold, spewing, moyst water, that feeds the flagg and rush. Yea, suppose this corruption that feedeth and nourisheth the rush or flagg should lie a yard or four foot deep; to the bottom of it thou must goe, if ever thou wilt drayn it to purpose, without which the water can not have its kindly operation, for though the water fatten naturally, yet still this coldness and moysture lies gnawing within, and not being taken away it eats out what the water fattens."

He goes on to say that when land is thoroughly drained, "The goodnesse of the water is as it were riddled, screened and strained out into the land, leaving the richness, and the leanness sliding away from it."

Notwithstanding this forcible way of putting one of the advantages of draining, the art made little progress in England. In 1763, more than a century after the publication of Bligh's book, Joseph Elkington, an unlettered but close observing man, came into possession of a wet farm in Warwickshire. Many of the fields were so wet that Mr. Elkington lost several hundred sheep by the rot, caused, as he thought, by the excessive moisture of the land, and he determined to make it dryer.

Having a large field of clay kept continually wet by the oozing of water from an adjoining bank, he cut a trench, four feet deep at the base of the bank, where the wet soil commenced, expecting to cut off the supply, but to his surprise the field remained about as wet as before. Suspecting that his drain was not deep enough, he ran an iron bar four feet deep into the bottom of it, and on pulling it out the water flowed in a continuous stream from the hole which he had made.

Pursuing his investigations further, he came to the conclusion that nature has subsoil drains as well as open ditches or rivers, and that water passes far below the surface of the earth, not only between the different strata of rocks but also between the different strata of earth, as between gravel and clay; and that springs are formed by these natural aqueducts reaching the surface of the earth. From his habit of close observation and long practice, Mr. Elkington became so skillful in discerning the strata, that he could trace the course of springs when there was no appearance of water on the surface.

His plan of tapping springs at their fountain-head and conducting the water by the shortest course to the natural outlet, is certainly a good one if we can only be sure of boring for the springs in the right place. The popular superstition that a rod of witch-hazel or willow, will in the hands of some persons point downwards spontaneously when they stand over springs, though having some currency given to it in the patent office report for 1851, will hardly pass for sound doctrine in this last half of the nineteenth century. We should much sooner pin our faith on the keen observation of such a mind as Elkington's than all the hazel and willow sticks in the country. Though the unlettered Warwickshire farmer drained extensive tracts of land for himself and neighbors successfully, awakened a general interest in the subject of drainage, and received from Parliament a grant of a thousand pounds for rendering so much waste territory fertile,—still his secret seems to have perished with him, and his system of drainage is not now practiced, possibly because we have not the close observation of its author.

To James Smith of Scotland we are indebted for laying the foundation of the present system of thorough drainage. He published the results of his experiments in 1832. Smith advocated locating the main drain along the bottom of the hollow, with frequent paralleled side drains running directly down the slopes into the main, as he maintained that in this way only could the strata of the soil, which crop out along the hill-sides, be effectually tapped, so as to let the water off. Smith, however, made the mistake which most experimenters in drainage make, of digging his trenches too shallow, and using stone instead of tile. In 1846 the British

Parliament appointed a committee to investigate the subject of drainage, and their report embodied the views of Mr. Smith, so far as the main and lateral drains are concerned, but advocated a greater depth, at least four feet, as more thorough, and the minor drains less frequent, the greater depth compensating for the want of frequency. The preference was also given to tiles over stone.

Josiah Parkis, the scientific engineer of the Royal Agricultural Society, about this time published his essays on the Philosophy and Art of Drainage, in which he brings out the two great benefits of drains; freeing the land from stagnant and injurious water, and allowing the rains to permeate and fertilize the soil with the rich gases they bring down from the air. This latter benefit seems to be the same idea that Walter Bligh had in his head nearly two centuries previous, when he spoke of the "fattening quality of water and its goodness being riddled, screened and strained out into the land, leaving its richness, and the leanness sliding away." The wonder now is that the idea of the "fattening quality of water" should have been so slow in its diffusion through English brains. It is, however, at length thoroughly diffused, and no country in the world is so perfectly underdrained to-day as is England. Half a million acres of fen-land in Lincolnshire alone, formerly worthless except for goose pastures, are now producing large wheat crops, fifty bushels to the acre not being an uncommon yield.

The introduction of thorough drainage in America has been as slow as in England. Besides the cheapness of land and the high price of labor which operated against its introduction, the impression was quite common that our climate was so much hotter and dryer than that of England, that though drainage was essential there, it was not important here. The idea of the value of drains in a season of drouth seemed paradoxical, and was slowly received. To John Johnston of Geneva, N. Y., a shrewd Scotchman, we are indebted for the introduction of the first tile drains used on the farms of this country. In 1835 Mr. Johnston imported some patterns of drain tiles from Scotland, caused the tiles to be made by hand labor, and used them on his own farm. The magical effect they produced was seen by his neighbors, and faith in tiles spread through Seneca County rapidly, and is now as universally diffused over the country as is the *New York Tribune.* Mr. Johnston preached drainage as well as practiced it, and Horace Greeley has done the same. The clay banks of Albany furnished great facilities for the manufacture of tile, and this city has thus far been the head-quarters of this now staple product. The demand is increasing beyond all precedent. The little town of Lenox, in the western part of this state, has the past summer made a market for some 50,000 of the Albany tile. Drain tile are now made in nearly all the northern states, and the manufacture is destined to increase. The country is pretty thoroughly awake to the importance of drainage. We formerly thought that manure lay at the foundation of successful farming in New England, but our later experience has been that the first thing that should engage the attention of the farmer is thorough drainage, taking from the land all the stagnant water to the depth of three or four feet.

CHAPTER XIV.

THE ADVANTAGE OF DRAINING.

AFTER this brief history of the art, we propose to consider, first, the advantages of draining; second, the lands that need to be drained; and third, the best mode of accomplishing the work. The first and most obvious advantage of drains is the withdrawing of the stagnant water. Water is good for plants and animals in limited quantity. Neither vegetable nor animal life can be sustained without it, but only marine plants and animals can flourish when submerged. Corn, oats and potatoes can be drowned as well as cows, horses and men. Drowned is the word that aptly expresses the condition of much of the soil of New England. For two or three of the summer months it has a chance to come to the air and breathe, but for the balance of the year it is suffocated, or is in the condition of a dropsical man, whose chest is so filled with water that he can only breathe with the top of his lungs. If any one has ever been afflicted with this dropsy in the chest, or has seen another person affected by it, and knows how difficult it is for the patient to do any work, hardly having air enough to enable him to walk,—he must have a little sympathy with the land in which, if you dig a hole a foot or two deep, water is found collecting at the bottom of it. The relief which the human patient feels when the water is drawn from his lungs is very analogous to the benefit which wet land derives from introducing tiles into it.

Plants breathe as well as men. The leaves and bark perform for the plant much the same functions which our lungs do for us. They must have air to elaborate the true sap, or the plants die. The roots also need air. If a dam is at any time raised so that the water flows back and surrounds the neighboring trees, they struggle for life like a man perishing with consumption, but eventually must succumb.

The water that submerges and drowns our fields has a twofold origin. It may descend from the heavens in the form of rain, or it may come from the earth in the form of springs. The latter is the water which does most of the damage. If the ground is not already saturated with spring water, the rains are seldom so abundant that the soil will not absorb all that descends from the clouds, and be greatly benefited by the absorption. The capacity of dry soil to absorb water is beyond what is generally supposed. A cubic foot of naturally dry or well drained soil will hold half its bulk of water. Whoever has undertaken to sprinkle his garden, or even a flower bed, with a watering pot, is disappointed at the amount of water required, and not less at the tax on the muscles. It seems a very easy matter for the Great Cultivator to open the windows of heaven and pour down his blessings in showers, till there is no longer room to receive them, but when man undertakes to water the earth artificially, this is work. After laboring till the water runs from his body as well as the watering pot, he is surprised, on digging into the earth, to find to how shallow a depth the water has penetrated.

We have little to fear, then, from the rains descending too copiously on well drained soil. Rains are pregnant with blessings to the farmer, provided his soil is in a condition to receive them. If the land is dry and porous, so that the water can permeate to the depth of two or three feet, it will leave its "fatness," as Bligh calls it, and the "leanness only slides into the drain." The power of the earth to absorb the fertilizing material in water is great. The most filthy, putrid water, filtered through a stratum of good loam, comes out pure and clear. We have put drain tile under a barnyard, to prevent the yard from being too wet, and to convey the surplus liquid to a neighboring meadow, and have seldom found the water at the outlet in the least turbid. The amount of ammonia brought down by rain to an acre of land in the course of a year is estimated to be equivalent to that contained in 300 pounds of guano, a very respectable top-dressing.

Besides the ammonia, rain water always contains in solution carbonic acid, which is attracted to the alkaline matter, producing disintegration and rendering available as food for plants the resources which nature always has on hand, stored away in the soil. To secure the advantage to be derived from the fertilizing gases, the rain must be permitted to percolate through the soil. It will most surely pay for its passage, if allowed the right of way. But if the land is already saturated with moisture, then the rains will flow over the surface of the ground, or remain in stagnant pools, and that which was designed as a blessing will prove a curse. The amount of rain which falls in New England from year to year varies from forty to forty-two inches, and he that does not provide in his soil a receptacle for the vast amount of fertilizing material that this rain brings with it, is either stupid or slothful, or amenable to both these charges.

A late popular writer on drainage takes this view of rain water, every drop of which, he says, is charged with fertilizing matter, and should have a free descent through the soil, but rejects all spring water as having already performed this mission on other lands, and therefore unfit for irrigating and fertilizing purposes as it again oozes or bubbles from the earth. We are ready to admit a great difference between spring and rain water. Whoever has watered his land with spring water must have observed the poor effect it has, compared with the rains and dews. After a shower, especially succeeding a long drought, when the air is surcharged with fertilizing gases, vegetation springs up with new life, is clothed with dark green, and evidently revels in abundance of food. Not so when watered artificially from the well or spring, however thoroughly the work may be done, unless the water is medicated with guano or other manure, when its effect may be even greater than that of a shower. Still we have seen good results from spring water carried over the surface of land which was well drained, and we are not prepared to say that it should always be conveyed away in subterraneous ducts as worthless. Spring water may not contain the gases that the rain is enriched with, but it often contains earthy matters in solution which are of great value. The analysis of the purest spring water shows traces of the salts of lime, potash and soda, in greater or less proportion, which the water has picked up in its passage through soils abounding with these salts, and is transporting to where they are more needed.

We would not advise carrying this spring water, nor indeed any water, on to land undrained, unless naturally dry; but where it can percolate the loam and find gravel or tile underneath to prevent its accumulation, we should not fear, but rather choose to conduct it on the surface of the earth. As it evaporates it must leave a deposit of enriching salts. Every housewife, living in a district where hard water, so called, abounds, must have noticed the deposit on her tea-kettle, composed mostly of sulphate of lime, or gypsum, which is excellent for the land. Some spring waters are so impregnated with lime that they will deposit a calcareous coating along their channels as they float in the open air, and will incrust or petrify solid substances which are immersed in them.

Sea water contains an abundance of saline matter, because the springs and rivers are continually dissolving and transporting it to the ocean, and there it accumulates; as when the water evaporates and is carried back to the land, the vapor is comparatively pure. In such internal seas as the Caspian and the Dead, having no known outlet, the accumulation of saline matter is still more rapid, as the evaporation is greater. The waters of the Dead Sea contain nearly one-fourth part of earthy matter, while those of the ocean contain from 2200 to 2800 grains in the gallon; and the common spring waters used for domestic purposes, some 20 to 30 grains. This may be a small amount in a gallon; but when we consider the thousands of gallons that issue from springs in a year, we shall find it worth saving. Farmers can not afford to despise small savings. With them the Scotch proverb, "Many a little makes a mickle," must have sway if they would enrich their lands, and by means of their land enrich themselves.

But we have dwelt as long as time will permit upon the fertilizing properties of water, when allowed to percolate through well drained soil. The virtues of the air, when freely admitted into the soil, are not much inferior to those of water. We have already alluded to its necessity in vitalizing the sap of the plant, much as it vitalizes the blood of our body as the air and the blood come in contact in the cells of the lungs. Another important office of the air in soil is to decompose the organic matter, and fit it to assume new forms of life. So long as water surrounds this vegetable matter, it can not decay. The same log that extended from the bank into the river, from which we were accustomed to dive when in bathing, nearly half a century since, remains to this day pretty much unchanged.

In our muck swamps we find, at the depth of six or eight feet, in a very perfect state of preservation, butternuts which must have lain there for centuries. Logs, also, are found at this depth which require an ax to cut them. Let these swamps be drained, and the air let in upon them, and the vegetable matter rapidly diminishes in bulk, and is converted into good rich mold. We look in vain for the butternuts when the muck has been placed in the compost heap for a month or two. The effect is similar when water is drained from land where clay abounds, with only a slight covering of a few inches of vegetable matter.

We have much of this land in Massachusetts, filled with little hummocks that are striving, like ship-wrecked sailors, to get their heads out of water so that they may breathe and live. Neither the plow nor the air can circulate among them, except it be during some drouth, and then the circulation is much impeded. The plow is clogged by the turf rolling up before it, and the air can not penetrate the clay, still saturated with water. Put some tile into this clay to the depth of three or four feet, and the whole appearance and nature of the land is changed.

The hummocks gradually settle down, the air penetrates not only through the superficial stratum, but down into the clay, and the vegetable matter can be mingled with the clay by the plow early in the season, and a good loamy soil be the result. The plow alone can not effect this.

Air is the great auxiliary which enters the soil as soon as the water leaves, and sets about its mission of decomposing all organic matter; which mission is just as important in the economy of nature as the formation of new life. Except the seed die how can it live again, and how can it either decay or live without the aid of air? One of the first principles of matter is its inpenetrability; that is, two particles of matter can not occupy the same space at the same time. Where water is, there air can not be; but let the water once be withdrawn, and air is sure to take possession and accomplish its mission. We have seen that common dry soil will take up half its bulk of water; of course air, being a more subtle fluid, will penetrate among the granules where water has been.

Another great advantage to be derived from draining is the additional heat imparted to the land. Wet lands are cold lands necessarily, in all climates. The temperature of water is very slightly effected, if at all, by caloric applied at the surface. The tea-kettle can never be made to boil except by having the heat under it. The skaters and fishermen upon our lakes kindle a rousing fire upon the ice, and pile on the fagots for many hours successively, with little melting of the ice. The reason of this is that water is mainly heated by change of place. If the caloric is applied at the bottom, the particles of water, as they become heated, expand and rise to the surface, and the colder particles at the top are forced down. If, on the contrary, the heat is applied at the surface, the particles of water, as they become warm, remain on top, and the conduction of heat downwards is so slight that it is only by careful experiment that we can perceive that it is conducted at all. The vessel in which the water is held may so conduct the heat as to render the water of nearly uniform temperature, but the conducting power of the fluid itself is infinitesimal, so that the sun makes slow work of heating a large mass of stagnant water.

Another cause for wet land being cold, is the amount of caloric that passes off in the vapor. Water, exposed to the air, is constantly passing from a liquid to a gaseous state, and the greater the heat of the air, the greater is the amount of water evaporated. A cubic inch of water, converted into vapor, occupies over a thousand cubic inches; its capacity for caloric is increased a thousand-fold, and it must, therefore, absorb caloric from all surrounding bodies. Both the ground and the air are made cool by evaporation. The cooling influence of evaporation is felt when we apply alcohol or ether to our heads. The washerwoman feels it to her sorrow, as she hangs out her clothes with wet hands of a cold day, and the boy, as he comes shivering in the wind from his bath in the lake. So great is the effect of evaporation upon the temperature of land and air, that we perceive the variations as we ride over the country, especially of a summer's evening, when we strike alternate currents of warm and cold air, the warm current coming over dry land, and the cold one over the wet meadow or the marsh.

Dr. Madden estimated that the soil of a drained field was six and one-half degrees warmer than a similar soil undrained. Few experiments have as yet been made in this country to ascertain the effect that drainage has upon the temperature of soils. Of course this effect will vary somewhat with the thoroughness of the drainage and the nature of the soil.

Josiah Parkes, one of the most skillful of the English drain engineers, experimenting upon a boggy soil, in the fore part of summer, found the drained bog at the depth of seven inches ten degrees warmer than the undrained. In the hottest days the difference must be still greater. The English climate is much moister than ours, and the evaporation is consequently less rapid; but even in England the average evaporation from wet soils is estimated, from experiments, to be two inches per month from May to August, inclusive. This gives two hundred tons of water to be evaporated each month from an acre of land. To evaporate this amount of water artificially would require twenty tons of coal.

Drainage also elevates the temperature of the soil, not only by carrying off the water which would otherwise have to be evaporated, but by letting in the warm air and rains. Rain may be sometimes cooler than the upper stratum of soil, but is generally warmer than the lower stratum, and if it has free access to this, as it does in well-drained land, it must be heated as it passes through the surface and convey this heat lower, thus producing an equilibrium. The action of the air is similar and more constant. The temperature of the soil is a subject which needs and will pay for further investigation. The soil is subject to less frequent and sudden changes, than the atmosphere, but we are satisfied that the expansions by heat and contractions by cold are trying to the tender roots, and are a prolific source of disease, and that drainage not only tends to elevate the temperature of the soil, but to prevent those sudden changes.

When our ears are frozen, the damage is not great unless we thaw them out too suddenly, and when a potato is frozen in the ground it suffers little, provided there is a sufficient covering of soil to prevent the expansion and bursting of its cells by a sudden elevation of temperature. Potatoes are most liable to rot when a warm, moist period is succeeded by a cold one, or the reverse. A wet soil is much more subject to these changes than a dry one. We have known the soil of a swamp frozen, when the temperature of the neighboring dry upland was far above the freezing point. Drainage will be found a most effective means of producing a high and comparatively even temperature.

Drains also lengthen the season at each end, causing the vegetation to start a fortnight earlier in the spring, and to hold out a fortnight later in the fall. This, in our short New England summers, is a consideration of no small importance. A few days for the corn crop sometimes make as much difference as a few inches on a man's head. The spring is our wet season, and we often have to wait many days for the winds and sun to disperse the superfluous moisture from our lands before they are fit to plow. The drain disposes of this water much more expeditiously. When land is thoroughly drained, it becomes as dry in two or three days after the frost is out of the ground, as it would be in two or three weeks when undrained. The gain in autumn is not much less. We have seen buckwheat on undrained land blackened by the frosts of September, when on the neighboring dry field the blossoms were unharmed.

Paradoxical as it may appear to those who have not investigated the matter, drained land suffers much less, if it suffers at all, from the drouths to which we are liable in July and August. Experience abundantly proves that lands that suffer most from drouth are most benefited by draining, and that it is possible so to deepen and mellow the soil that the hottest and dryest period produces scarcely a perceptible effect on the growing crops. The lawns of the Central Park, where tile have done their perfect work, seem to pay as little attention to the drouth, as the ox does to the fly on his horn. They are always green, whether the heavens are brass or not, though they are located among the rocks, where we should expect to see brown fields occasionally. There is no witch-hazel mystery about this. There is always the same amount of water in and about the earth, in summer and winter, in seasons of flood and in seasons of drouth. What the soil loses in a hot, dry time, the air gains, and, like a faithful banker, the air is ever ready to honor the drafts which the soil may make for its deposits. The vapor is kept in the air by means of heat; and whenever the air comes in contact with a substance cooler than itself, it loses its heat, and must lose some of its moisture, as its capacity for holding water is diminished, in the same manner that the capacity of a rubber ball is diminished when contracted. Hence the deposit of dew upon the ice-pitcher, in the middle of a hot summer day, and a similar deposit at night upon the grass. When the land is drained, so that the air can circulate among the lower and cooler strata, the same deposit must be made of moisture, and it is made where it is very convenient for the roots to receive it. By experiment it has been found that a thousand grains of common dry soil absorb in the course of a warm summer day 22 grains of water; loamy clay absorbs 26 grains; and good garden soil, 45 grains.

Besides this power of absorption from the air, well drained and pulverized earth brings up moisture from beneath, when occasion demands, by capillary attraction, in the same manner that a sponge takes up water, or a lamp wick conveys oil from the bottom of the lamp to the point of combustion. These are wonderful provisions of nature, and beautifully illustrate the principle that Providence helps those who help themselves. The same air floats over the drained and undrained farm, but deposits its refreshing and fertilizing moisture only in the soil to which it has free access.

But the great benefit, which drained or deep soil probably has, is the depth to which the roots of plants are permitted to run. If the roots are confined to the surface, they must necessarily be parched in a hot, dry day. Crops, like sheep, delight in a wide range. If a cold, watery subsoil does not intercept their downward march, they will forage to the depth of four, five, and even six feet. When they penetrate thus deeply, they are in the situation of a man with a surplus capital to draw upon when a drouth in the money market occurs. When roots run down three or four feet, the surface of the soil may be dry and they are not affected.

It was in allusion to this deepening of the soil by drainage, that Emerson, in an address at Concord, once playfully but truthfully said, "Concord is one of the oldest towns in the country, far on now in its third century. The selectmen have, once in five years, perambulated its bounds, and yet, in this year, a very large quantity of land has been discovered and added to the agricultural territory, and without a murmur of complaint from any neighbors. By drainage we have gone to the subsoil, and we have a Concord under Concord, a Middlesex under Middlesex, and a basement story of Massachusetts more valuable than all the superstructure. Tiles are political economists. They are so many young Americans, announcing a better era, a day of fat things."

We wish that the desire of more land, the easily besetting sin of farmers, could be directed to extending their dominion perpendicularly instead of longitudinally. Their title gives them possession to the center of the earth, but practically they possess only a few inches of the surface. This subsoil costs nothing but a little labor in its redemption from its sunken, degraded position, requires no additional fencing, and when paying heavy interest on the price of redemption, is seldom thought of by the assessor.

Massachusetts has a small superficial area in comparison with some of her sister states, but she sustains the greatest population in proportion to her area, and can be made to sustain a still larger by draining and deeper tillage; and the increasing demand for agricultural products warrants an increased outlay in bringing to light the treasures of fertility which are now hid in the subsoil. The great agent that unlocks these treasures is the oxygen of the air, and this must have free access and free play down deep in the hidden recesses, and it will prepare the way and be a sure forerunner for the roots of plants.

We have time to allude to only one more advantage to be derived from thorough drainage, and this is the increased dryness and purity of the air. This is more strictly a hygienic than an agricultural benefit; but health being one of the greatest blessings of life, it must not be neglected by the farmer. The abundant crops of the rich bottom lands of the West are a poor compensation for the chills and fever which are there generated. Fortunately, most of New England is naturally so well drained, by her rapid running rivers and brooks, that we seldom shiver and shake from the peculiar malarious fevers which infest extensive marshy districts; still we have the more deadly typhoid fever, and every precaution should be taken to avoid this scourge. A dry atmosphere is one of the greatest promoters of health, and dry air can only be secured where there is a dry soil. It is a mistake to suppose that the air of our mountain towns is always pure. Marshes and wet meadows and pastures are about as abundant on the mountains as in the valleys, and fevers are by no means confined to the lowlands.

Doctors disagree as to the nature of malaria, but they agree in assigning its origin to wet, marshy places, and in asserting that the health of a country is promoted by making the soil dry. A late writer, Dr. Salisbury, in the *American Journal of Medicine*, claims that he has discovered the cause of malarial fever in the spores of a very low order of plant, which he collected on plates of glass suspended over marshes, and which he asserts are carried in suspension only in the moist exhalations of wet lands. This theory may need further confirmation, but the general principle that dry air is conducive to health, is fully confirmed, and if any farmer has a current of damp air sweeping over his premises, he will drain his land, if he puts a just estimate on the blessing of health.

CHAPTER XV.

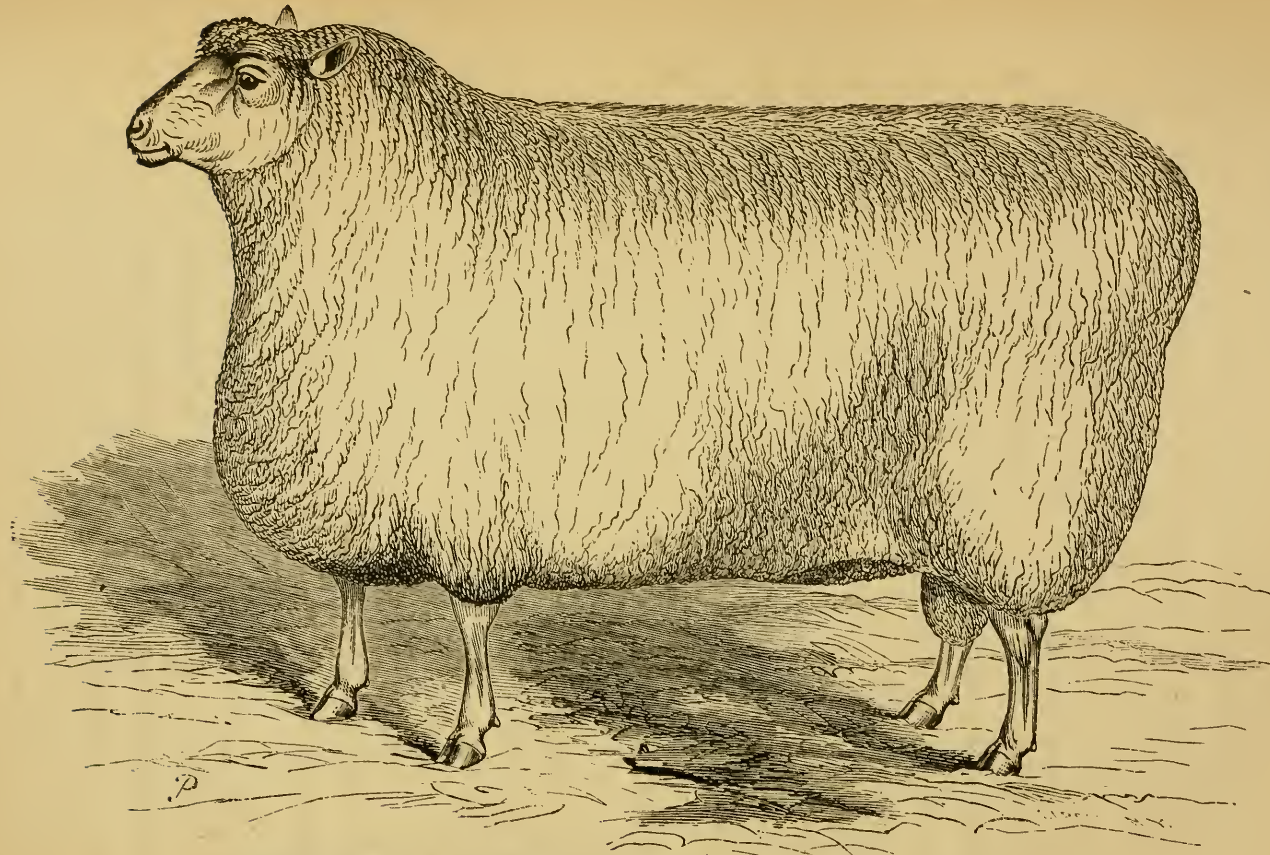
WHAT LANDS NEED DRAINING.

THE next topic, what lands need draining, we must pass over briefly. We can not agree with Horace Greeley, who affirms that all lands worth plowing will be improved by draining. We have vast tracts of sandy loam, and even of clay loam,—where there is underlying sand or gravel,—that is good plow-land and needs no tile, for it is sufficiently drained already. Still we think much more land can be improved by drainage than is generally thought.

At first it was supposed that swamps, marshes and hill-sides abounding with springs, alone needed draining, and open ditches were the only means for drawing off the superabundant water; but as experiments and observations continued, and blind ditches were introduced, it was found that clay lands and clay loams, and even sandy loams, when the subsoil was of a hard clay nature, were greatly benefited by tile. More upland by far is now being drained than swamps and low boggy lands. In addition to the question of improvement, the Yankee always asks, "Will drainage pay?" and as the question of profit is intimately connected with that of improvement, we will consider them together in discussing what lands should be drained. In the neighborhood of cities and villages, where land is worth $100 or more per acre for tillage, it will pay to drain when it will not pay where good land can be bought for what the draining costs. Health, too, may require drainage where pecuniary profit may not demand it. A field also may be so situated that we desire to keep it as a permanent meadow, and in this case drainage may not be as necessary as where the plow is to be used. Grass will grow and pay a profit where corn and potatoes will not.

It is difficult to lay down rules of universal application on this subject. The observation and good judgment of each individual must guide him in his individual labors. Most generally we can determine by the surface indications of the soil, whether it needs to be honey-combed with tile or not. Bildad, the Shuhite, in his talk with Job, gives us one observation worthy of consideration here: "Can the rush grow up without mire? can the flag grow without water?" The character of the herbage is determined very much by the nature of the soil.

We do not find tall timothy nor rank clover growing where the water-table comes near the surface of the ground. Where the land cracks in a time of drouth, or the mouse-ear grass, or the coarse aquatic grasses and herbs grow, there we should use the tile before we should the plow, and we are inclined to think that the so-called diviners, who go over the land with witch-hazel sticks in their hands to point out where wells can be dug, are more governed by their keen eyes than by the hazel sticks. They sometimes submit to be blindfolded, but they manage to get an observation, and the simple owners of the land are oftener hoodwinked than the self-styled diviners. Wherever the clover or the corn leaves are curled in the middle of the day or in the time of drouth, it is a pretty sure indication that there is not sufficient depth of earth,



IMPORTED COTSWOLD RAM—"HIS ROYAL HIGHNESS."

Bred by Robert Garne, Aldsworth, England. Imported by and property of Burdett Loomis, Windsor Locks, Conn.

and that the subsoil needs to be penetrated with tile so that the air can enter and crumble it. An experienced eye will detect in the color of the grass and grain a similar indication. The grass has a much lighter green, and the grain a tinge of yellow. If water stands on the surface for any length of time after a shower in summer, or follows the plow after the frost is out of the ground in the spring, then tile are absolutely essential for successful tillage.

Surface indications do not always tell the whole story of the wants of the soil, as to drainage. We have seen lands that we called good, loamy plow-lands, on high gound, too, where the surface water had no opportunity to collect, greatly benefited, at least doubled in their products, under the same cultivation, by the use of tile. Digging into these lands, we find the loam to extend down only eight to twelve inches, and that under this loam a hard pan, consisting of clay, gravel and sand, exists, that is almost impermeable to water and impenetrable by the roots of plants, and must be picked before it can be shoveled. Such a subsoil farmers significantly call a hard pan, as it is almost as compact and hard as mortar. Such soil, that will produce without drainage fifty bushels of corn to the acre, or 150 bushels of potatoes, or 400 bushels of carrots, can, by thorough draining and deeper plowing, and with the same amount of manure, be made to produce 100 bushels of corn, 300 of potatoes, or 800 of carrots. Not many years will be required on such a soil for the increased products to pay for all the outlay in drainage. The increased crop of carrots in one season will often leave a balance after paying this outlay, and the investment is one that lasts as long as well laid stone walls last.

One of the best tests of the necessity of drainage, is to dig a hole to the depth of three or four feet, and if in the spring, when the frost is fairly out of the ground, or at any time during the summer when the brooks and springs are full, water collects in this hole, we have abundant proof that this surplus water requires to be carried off by tiles. Grass may grow on such lands and yield tolerably remunerative crops with good top-dressing, but we should expect potatoes to rot, and corn to look yellow and feeble, and make poor returns for our labor.

The expense of draining an acre will vary with the nature of the soil and the depth and frequency of the drains, and is variously estimated at from $25 to $75. Estimating the expense at the highest figures, it will take only a few bushels of corn or potatoes to pay the interest on the cost of the improvement, and whatever surplus is gained over the interest may be put down to the account of profit. With the drains thirty feet apart, it will require 1340 tile of the usual length of thirteen inches, to drain an acre, and the expense of these has generally been $10 a thousand, making the outlay for the tile $13.40. They cost something more in these days of inflated prices, but they can and should be manufactured for less, and as the demand increases, competition will reduce the price to a more equitable rate. The labor of putting down the tile can be performed by the farm hands, as it requires no engineering skill, when the ditches are once laid out, to dig them and put in the tile.

How shall we drain our lands, is a question that admits of but one answer. Our fathers tried the open ditches, and found them very inconvenient. They were a great obstruction to the plow and cart. They wasted much land, for besides the amount of land occupied by the ditch, originally, the tendency continually was to an enlargement by the sides caving in, and they also carried off much of the finer portion of the soil, which was liable constantly to be washed into them. Every spring these open ditches required to be cleaned out, or they would soon fill up completely. The first cost of open drains may be small, but all things considered they are expensive, and with the few exceptional cases, where they seem to be necessary, we may put them down as among the things that were. They were followed by stone drains, which were a great improvement on their predecessors, as they did not disfigure nor waste the land. In case the stones lay on the surface of the land to be drained, it seemed like killing two birds with one stone to rid the land of stones and convert them into drains. But stone drains were found to be both expensive and liable to be choked with dirt. Tile have proved to be a more economical and efficient mode of draining, and whoever wishes the usual epithet of "thorough" applied to his draining, will use nothing else. The ditches are so easily dug, and the tile are so quickly laid, and when laid are so efficient and permanent, that even when the stone are on the land to be drained, we should recommend the use of tile. If drainage is the end we wish to accomplish, and the removal of the stones a secondary consideration, we should not run the risk of a failure in the main good in order to secure an inferior advantage.

We have said that it requires no engineering skill to dig the ditches and place the tile. To locate the ditches, so as most effectually and economically to accomplish this object, to fix upon the proper depth and the best termini, to ascertain the grade and the right intervals between the ditches,—these are subjects demanding more mind than muscle. There is science in draining, as in every other art, and much money has been sunk in ditches that were improperly located and constructed. Before undertaking any great enterprise in drainage, these subjects should be studied. Not every emigrant from the Emerald Isle, that can handle a spade and has dug ditches, can tell where to locate them. Gisborne well says of the draining conjurers, who are quacks in the science, and whose skill consists only in the adroit use of the spade, "These fellows never go direct about their work. If they attack a spring, they try to circumvent it by some circuitous route. They never can learn that nature shows you the weakest point, and that you should assist her; that 'hit him straight in the eye' is as good a maxim in draining as in pugilism."

There is much truth in this. One of the most frequent mistakes of these itinerant quack drainers is to attempt to cut off the springs that are oozing from the side of a hill, by running a horizontal ditch, where the water first makes its appearance. They think that a drain across the slope will head off all the water that issues from the springs lower down, and forget that these lower springs are fed from strata which the upper, horizontal ditch in no way affects.

If the water runs over the slope from some higher table-land, as it runs over the apron of a dam, then a horizontal drain might intercept it; but, oozing as it generally does from different strata,—located somewhat like stairs,—cutting off the water that comes from the upper stratum is only cutting off one head of the hydra. Longitudinal draining with tiles is nonsense. Water obeys the great law of gravity, whether in tiles or out of them, and will run out of the lower side of tiles with as much agility as it ran into them on the upper. Nature teaches in her great system of drainage the true principle: water always seeks the most direct course down the slopes. If we wish to irrigate lands, we can dig horizontal ditches; if we wish to drain the soil, the tile must be laid directly down the slopes.

But we can not, in one lecture, enter into the minute rules of drainage, nor is it necessary. Have they not been fully elucidated by English authors, and by Judge French and Col. Waring of our own country? To them we must refer you for the details. The subject is one that will well repay for thorough investigation. We have yet to meet with the farmer who has expressed any regrets at his efforts in drainage. Some acknowledge having made mistakes, but all are delighted with the general results of their efforts. There is a pleasure in redeeming land from the dominion of water—land given up to cat-tails and hard-hacks—and seeing it yield bountiful crops for the support and comfort of man,—very analogous to the pleasure of the Creator, who, at the end of his six long days in fitting this world for the abode of intelligent beings, looked upon his works and pronounced them good.

LECTURE FIFTH.

CHAPTER XVI.

MINERAL FERTILIZERS.

THE farmer finds in the soil a bed prepared for the growth of vegetation by chemical and mechanical agency. This bed, as we have seen, is the work of ages. The rocks have been broken down and ground by the agency of air, water and ice, chemically decomposed, and mixed and distributed by a combination of forces under the direction of the great Agriculturist, till they have formed that pulverized portion of the earth's surface which we call soil, and which is so wonderfully furnished with the inorganic constituents of plant-food. Man, the final, crowning work of the Creator, can not live upon these earthy matters, till they have first passed into the lower organization of the vegetable, and clothed the earth with a verdure which is so beautiful and useful, that we are at a loss which to admire the most, the beauty or the utility. In a state of nature, the elements of fertility are constantly increasing in the soil, whether covered with majestic trees, as in our forests, or waving grasses, as on our prairies.

In the case of the forests, the leaves and branches fall and decay, and the soil is yearly improved by a rich deposit of vegetable mould, so that in some mountainous districts and on some barren, sandy plains there is no better mode of restoring the soil to its virgin fertility than by planting it with trees. In from twenty to thirty years we get a growth of timber, and when this is cut off the land is found capable of producing good crops for a succession of years. The process is very similar on the prairie. The grass perishes where it grows, when the organic and inorganic constituents are both returned to the soil; or the fire sweeps over the prairie, in which case only the earthy matters are left, and the organic are restored to the air from which they were derived. It might seem, in the latter case, that there is no increased fertility, as the ashes are derived directly from the soil, and no more is returned than was abstracted; but these salts are brought up by the roots from a considerable depth, and left on the surface, where they are more available as plant-food; and it must be remembered, too, that the burning is not a result of a condition of nature. Prairies never take fire from the sun. The burning is always the result of human interference, and though the enrichment of the soil is slower when the grass is burned than when the vegetable mould accumulates by slow decay, still the increase of the salts, in an available state as food for plants, is very perceptible. Not so when man tills and crops the ground, and carries his crops to the barn to be fed to animals, which, in their turn, are transported to supply the wants of the village or city; or worse still, when the crops themselves are thus transported, without first passing through the animal economy.

Under this artificial cultivation by man, the soil must deteriorate, unless special care is taken to restore to it, in some form, the elements which the crops carry off. We regret to add that on many, possibly a majority of farms in New England, this special care is not taken, and consequently the lands are growing less and less fertile. In the neighborhood of cities and villages the improver has taken the place of the exhauster, but in the country generally, especially in districts remote from the stimulus of manufactures, exhaustion is still the rule. The impression with most farmers seems to be, that if the hay and coarse products generally are fed out upon the place, and the manure resulting from these is restored to the land, the grains, milk and beef may be sold and the farm still be kept in its original fertility.

This is a great mistake. The manure from the coarse products is not a full equivalent for the crops yielded by the soil. Every bushel of grain, every cheese, and every ox sold, must carry off more or less of the salts of the soil. We do not object to the sale of these commodities, provided a full return is made to the land for all it yields, but to suppose that 1000 pounds of phosphate of lime can be removed from the farm yearly, and only 500 returned, and that exhaustion must not be the final result, is not in accordance with the simple principles of arithmetic. Lands naturally rich may endure this process for a series of years and not show much deterioration, but exhaustion must follow sooner or later where more is given than is received.

Another quite frequent mistake of the cultivator is in supposing that some one specific manure is an equivalent for the many elements of fertility which the crops carry off. Thus we have often heard it said that hay could be sold from a farm, if plaster, (sulphate of lime,) could be bought to supply the place of the manure which the hay would make. Another farmer puts his reliance in bone dust (phosphate of lime), and still another in guano. These are all good manures, but the plant can not live on lime alone, nor guano alone. The analysis of the plant shows that it is composed of many elements, and it must be supplied with them all, or it can not live. Where the soil is rich in all the elements of plant-food save one, then the supply of this one works wonders. Bone dust on an old pasture, which has furnished the skeletons of many generations of animals, acts sometimes like magic in restoring its fertility. Plaster on some soils has worked so effectually, that farmers have thought that it was a sovereign panacea for all the ills the farm is heir to, but after a time it loses this wonderful power, and the land becomes "plaster sick," as the expressive phrase is. In some parts of the country, where plaster for a time was relied upon as a substitute for barn-yard manure, it is now discarded altogether, and is condemned, as making the father rich and the son poor. The simple truth is, that when the plaster was first used the land was deficient in the elements which this mineral furnished, and the stimulus which it gave to vegetation, after a time exhausted the soil of other elements equally necessary. The mistake was not in using plaster, but in relying upon it as the sole manure.

No plant nor animal has the power of generating the materials of which it is composed. That mysterious principle which we call life causes wonderful changes in the animal and the plant, but creates no new matter. The combinations of the different elements in the vegetable economy are exquisitely delicate and accurate, and the results are a perpetual miracle. How the plants can work up the matter in the soil and the compost, into forms of such delicacy, symmetry, and beauty, is a mystery man can never solve. But unless there is iron in the soil the plant can not create this element, and can not give its leaves and flowers their exquisite coloring. It can not convert potash into soda, nor sulphur into phosphorus, though possibly it may to a limited extent substitute one element for another, when one is deficient.

One crop may demand more of one element than another, as the ash of potatoes shows that this crop requires an abundance of potash, while the prominent constituent in the ash of wheat is phosphate of lime. In manuring for these different crops, special reference may be had to their special necessities, but let no one suppose that potatoes can thrive upon potash alone, or wheat upon phosphate of lime. Other elements are equally necessary as these, though not in such abundance, and the plant cannot furnish them for itself, and droops and dies when they can not be found. The power of the mysterious principle of life is truly wonderful, but we must not expect too much from it. Life, neither in the vegetable nor the animal, can create something out of nothing.

Barn-yard manure, especially where roots and grain as well as hay are fed to the stock, must contain more of the elements necessary for the reproduction of these crops than any other fertilizer, and must ever be the main reliance of the farmer to keep his land in good condition. But even when all the crops are fed upon the farm, there must still be a drain upon the fertility of the soil, as we have seen in the milk, beef, and other animal products sold. Skillful farmers see this, and either buy additional manure, or feed more grain and hay than their farm produces.

We once asked an enterprising farmer, who was feeding a large number of beef cattle on corn imported from Illinois, if he could afford to buy grain to convert into beef, and his significant reply was, "I am feeding my land at the same time I am feeding my cattle. I may possibly lose a little on the beef, but I shall gain on the farm." No farmer can afford to let his land deteriorate. It is his stock in trade, the capital on which his business is done. We should expect the banker to come to bankruptcy who made dividends from his capital; and the manufacturer, who diminishes from year to year his working power, will finally have no power to work with. In like manner the farmer who exhausts his soil will find his crops growing beautifully less, and though he may not become bankrupt (farmers seldom fail), still he will have to seek a new location and a virgin soil, where he can keep soul and body together, and where the exhausting process may be repeated.

In selecting a location for farming purposes, a man of wisdom will look well to its natural fertility and to a convenient market for his products. However fertile the land may be naturally, he will not rely upon this fertility as incapable of deterioration or improvement, for perfect land is as difficult to be found as perfect men. His first step in the way of improving the soil will be to drain it of its superfluous water, if this may be necessary, and the second endeavor will be to maintain, and, if possible, increase its fertility. If drainage is the fundamental thing in good husbandry, as we are inclined to think it is, the superstructure consists mainly in the multiplication and application of manures. When land is well drained, the great secret of great crops is abundance of manure. A manufacturer who has recently turned his great energy to agriculture, lately said to us, "There is no trick in raising good crops, if I only have manure enough." This is in a measure true, but some skill is requisite in the application of manure and the management of the crop, or else much energy and money are wasted.

Crops, like animals, must be fed, and like animals they must be fed judiciously. Not every one that has an abundance of feed uses it most effectually in producing growth, milk, or fat, according as his object may be in feeding. The course adopted to produce the best results in one case may not be equally effectual in another. Plants differ from animals in this respect: they can not wander from place to place in search of food. The roots do, indeed, forage, and where the soil is deep and mellow, as it should be, they forage more extensively than is commonly supposed; but still where the seed falls, there the plant must grow, and if it does not find sufficient food, withers away. The great question with the stock-grower is, "How shall I feed my stock so as to secure the most profitable return?" And in like manner the great question with the agriculturist should be, "How shall I feed my crops?" The answer is a simple one,—manure them thoroughly, manure them discriminatingly.

In unfolding this answer, we must have a clear idea of what manure is. Webster defines it as "any matter which fertilizes land; as the contents of stables and barn-yards, marl, ashes, fish, salt and every kind of animal and vegetable substance applied to land, or capable of furnishing nutriment to plants." It is difficult to give, in a concise definition, the full meaning of a general term. The great lexicographer should have included mineral with the vegetable and animal substances. The time must have been when mineral matters only existed on the earth. Then came the lower forms of vegetables, and with them the lower forms of animal life.

When darkness was upon the face of the earth, there could have been no vegetation, but since the command went forth, "Let there be light," there has been a ceaseless round of animal and vegetable life. Every thing that has once lived is designed and can be made to live again. Life follows death, just as surely as death is the consequence of life. From the disintegration of the rocks, the decay of vegetation, and death of animals, come forth new life and beauty. Rocks, vegetables, and animals are the three great sources of fertility, and we will briefly treat of manure under the three heads of mineral, vegetable, and animal manures, classifying them according to their origin.

No classification is perfect. As it is difficult to draw the line between the animal and vegetable kingdom, the lower animals having many of the characteristics of vegetables, so the vegetable and animal manures have many properties in common, and both contain more or less mineral elements.

Under the head of mineral manures, we include all substances, whether simple or compound, which consist entirely of earthy or inorganic matter. Phosphate of lime and wood ashes will be considered as mineral manures, as they are purely earthy matter, though the former is mostly derived directly from animals, and the latter from plants.

Under vegetable manures, we include all substances derived immediately from the vegetable kingdom, which are mixtures of organic and inorganic matter, as no plant grows that has not more or less mineral matter in its composition. Animal manures are also mixtures, and we class under this head all those mixed substances derived directly from the animal kingdom, as animal excrement, hair, flesh, etc.

CHAPTER XVII.

CARBONATE OF LIME AND PLASTER.

OF the mineral manures, those chiefly used are carbonate, sulphate and phosphate of lime, and wood ashes. The two former are obtained directly from the rocks, the phosphate mainly from bones of animals, and ashes are the saline and earthy remains of burned plants, and include more of the inorganic elements of vegetation than any other manure, whether mineral, vegetable, or animal, that we use.

Lime is the mineral manure that has been more extensively used in this country and Europe than any other. By some agricultural writers, it is spoken of as the key that unlocks the soil, and enables it to pour its treasures into the lap of the farmer; by others, who have tried it without benefit, it is utterly discarded; others still testify that it does good for a time, but after a few years' application it impoverishes the land. We have no doubt these contradictory statements are honestly made, and are the true results of actual experiment. Those who have found lime so beneficial, have used the right kind on soil that was deficient in this element, and it has worked so charmingly that they are ready to ascribe to it all the virtues ever claimed in their lines for the "Elixir of Life," or "Macassar's incomparable oil."

Those who have perceived no benefit from lime, have either used magnesian lime, or applied it to soil already sufficiently supplied with this element. The complaint that lime does good for a time, but in a succession of years impoverishes the soil, is well sustained by facts, but the lime is not to blame for the deterioration.

Plants can not live on lime alone. Turnips are good for cows, but we should consider a farmer a simpleton, who on feeding a few turnips and finding that they increased the flow of milk, should conclude to feed his cows nothing else. Pure, caustic lime can only furnish one element for the support of vegetation, whereas a dozen are required. When lime is relied upon as the sole fertilizer, the soil must deteriorate rapidly, as the decomposition of the organic elements is hastened by contact with it. The gases arising from the decomposed vegetable matter stimulate the growing crops, which in turn draw more largely on the mineral elements, and exhaustion must follow speedily, unless the land is unusually rich in all the elements of fertility. The exhaustion does not come from the use of lime, but from growing large crops with only the return of one element for food. Some have supposed that lime decomposes the vegetable matter faster than the growing plants can take it up. This is possible, but we very much question whether there is any waste of the gases from this cause on tillable land, as good loam always contains sufficient clay and carbonaceous matter to absorb all the gases that may be liberated by lime, and to retain them till they are called for by the growing plants. On barren sands there may be some waste, and if it is possible to ruin such a soil, lime, when used without other fertilizers, will quickly reduce it to the condition of the cursed, barren fig-tree.

Because the cow fed on turnips alone gives an unusual flow of milk for a day or two, but soon pines away and dies, it is not righteous judgment to attribute the cause of her death to the turnips, neither is it right to attribute the deterioration of land to the use of lime. It is only one of the many instances where land is starved for the want of a greater variety of food. Even guano, the richest of the commercial manures and containing a much greater variety of plant-food than lime, has been found inadequate, when used alone, to sustain the fertility of a field for a series of years.

Lime is never found in nature in a pure state. That which is used in agriculture mostly is the carbonate of lime. As it exists in the rocks which we variously call limestone, marble, or chalk, the composition is nearly one-half carbonic acid, which is easily expelled by heat. A hundred pounds of dry, pure limestone, when burned in the kiln till the carbonic acid is thoroughly expelled, is found to weigh only 56 pounds, thus showing that 44 per cent. is carbonic acid; but so great is its avidity for this acid, that it is no sooner cool than it begins to absorb it from the air again and to increase in weight. Limestones are, however, seldom pure. In the best quality, some 5 per cent. of other mineral matter—chiefly silica, alumina, and iron—is found. It is the latter which, on exposure to the air, rusts, and causes the stains which so much disfigure some of our marble buildings.

But the great defect in the limestones of New England is the magnesia, which sometimes constitutes 40 per cent. of the rock. Magnesia is one of the elements necessary for vegetation, but there are few soils that are not supplied with the small amount requisite, and an excess of it is positively injurious; and more prejudice has been excited against lime from the use of magnesian limestone, or dolomite, as it is generally called, than from any other cause. Dolomite may make good mortar and good building stone, but must be used as a fertilizer with much caution.

Shell-limes are free from magnesia, and they contain also a small quantity of phosphorus, and must be useful wherever lime is needed in the soil. It is a common mistake to suppose that land overlying limestone must necessarily abound with this element. This would be the case if soils were made up by the disintegration of the contiguous rocks, but we have seen that soils are the result of drift brought from remote localities, and are composed of the debris of a variety of rocks; thus fitting them for a degree of fertility of which they would not be capable were they constituted solely of lime, clay, or sand. Through the whole length of Berkshire County runs a stratum of limestone, which, in the valleys, often crops out on the surface, but lime, judiciously applied on Berkshire soils abounding in vegetable matter, never fails of doing good service.

The action of lime in agriculture is threefold. It forms the direct food of all plants to a greater or less extent. This is shown by the fact that lime is found in the ash of every vegetable. Thus an acre producing twenty-five bushels of wheat each year, must lose some ten pounds of lime; fifty bushels of oats will carry off twenty pounds of lime; twenty tons of turnips, in roots and tops, furnish in their ash over one hundred pounds of lime; five tons of potatoes (tubers), twelve and one-half pounds of lime; and two tons of red clover, one hundred pounds of lime. These amounts will vary somewhat with the abundance of lime in the soil, but lime is never wanting in any crop, and may therefore be considered an indispensable article of food for all plants, some requiring more than others. Johnston estimates the average yearly quantity of pure lime taken from the soil by the crops at sixty pounds.

The second great advantage of lime is its chemical action on other substances, neutralizing acids and decomposing the organic matters, both vegetable and animal, thus rendering them available as food. This chemical action is probably the cause of its great efficacy in particular locations, and two or three principles established by long observation, must be remembered in the application of this mineral manure: first—that lime has little effect where organic matter is deficient; second—that its influence is more perceptible when it is applied near the surface of the ground where the air has ready access to it; and third—that under its influence organic matter rapidly disappears in the soil, and when the supply is reduced too far, lime ceases to have any beneficial effect.

The third method in which lime acts on the soil is mechanical. It breaks down a hard, stiff clay, and makes it more friable, thus letting in the air and heat. A mucky soil it makes more compact. On these two kinds of soil the mechanical effect is always good, but on a light, sandy loam the effect is often injurious, making more porous that which was already too open.

The amount of lime to be used, and the mode of its application, vary so much with circumstances, that it is difficult to lay down rules which will be universal. If only sixty pounds are carried off annually in the crops of an acre, the amount required as direct food for plants can not be large, but as it is an established principle that where land is rich in mineral elements the amount taken off in the crops is larger than where there is only a scanty supply, it is not worth while to put the land on a short allowance, especially when lime is so cheap. The indirect benefit of lime in decomposing organic matter, and rendering clay soils more friable, will also compensate for liberal doses. One of the best modes to apply lime is to slake it with brine, using three bushels of fresh lime to one of salt, dissolving the latter in as little water as possible. We thus get two more elements of plant food, chlorine and sodium. If the lime thus slaked can be composted with muck, it will destroy the acidity of the latter, hasten its decomposition, and the various compounds of lime, chlorine, soda, carbonic acid, and the salts contained in the muck, can not fail of being beneficial to land requiring manure.

If the land on which we wish to apply lime is of a peaty nature, then it may not pay to compost it with muck, but on clay or sandy loams, its application in the compost form will be found far more efficient.

When used pure, lime often forms in the soil a kind of mortar, and the hard lumps do not readily yield food to the plant. When mixed with from six to eight parts of muck, the caustic effect of lime does not injure the tender herbage. It can also be more evenly spread, and no exhaustion of the organic matter in the soil can follow its use, if muck be applied at the same time. Some inexperienced persons make a compost of caustic lime and manure, but there is great waste in this method, as the lime decomposes the manure rapidly, and the gases pass off into the air. It is never safe to put lime in direct contact with ammoniacal manures, unless an abundance of loam, muck, pulverized charcoal, or other carbonaceous matter be used at the same time, to absorb the escaping ammonia.

The tendency of lime is to sink into the soil, and hence it should never be plowed in, but always applied near the surface. The action of lime upon organic matter is slight in the absence of air and light. Air may penetrate to some depth in the soil, but light must be confined to the surface, and the light of the sun accelerates nearly all the chemical changes that take place. The practice of the best farmers is to keep all manure nearer the surface of the ground than formerly; certainly this must be the practice with lime, if we expect to reap full benefit from its use.

Next to pure lime, the mineral manure most used is plaster, the sulphate of lime. This rock is not so extensively diffused as the carbonate of lime, and we know of no deposit of it in New England, but gypsum can be obtained in most places, ground into powder for agricultural purposes, at $10 per ton. When its action is beneficial, there is no cheaper manure than this. Plaster contains two elements of plant-food, sulphur and lime, and therefore acts beneficially on a greater extent of land, and on a greater variety of crops, than does pure lime. The mechanical effects on the soil may not be as great as lime, but this defect is more than compensated by its absorbing power.

It has been a matter of astonishment with some, how a bushel or two of plaster could produce such astonishing results on an acre of land. Seven years of plenty have sometimes followed its introduction upon a farm, and we are sorry to add that seven years of famine have also succeeded the years of plenty, when it has been relied upon as the sole fertilizer. Farmers have sowed a strip across their pastures with plaster, and have for years afterward been able to discover the track of the sower by its green and luxuriant herbage, and some have even boasted of writing their names on their fields with plaster. There is no magic in this.

Plaster is a compound of sulphuric acid and lime, both entering into the composition of vegetables, and is also a great absorbent of the gases on which plants mostly live; and when circumstances are favorable for its full effect, there is no manure so cheap, so efficient, and so easily applied. Sulphur is a constant and apparently necessary constituent of the several varieties of grain and grass, and is especially abundant in red clover, peas, and beans. The analysis of the ash of common meadow hay gives about 10 per cent. of sulphate of lime, while the ash of clover gives 30 per cent.

Science and practice agree in prescribing gypsum as the special manure for leguminous plants. The sulphur they require must be obtained from the soil, and if this element is deficient, it can in no way be so cheaply applied to the land as in the form of sulphate of lime. Diluted sulphuric acid has much the same effect as plaster, which proves that it is the action of the sulphur in the plaster which produces the great effect. Gypsum requires much water to dissolve it, and in dry soils and seasons it sometimes fails to produce the effect which is manifest on the same land in a wet season. A gallon of pure water dissolves only one-fourth pound of gypsum, and it is only when in a state of solution that it can enter into the composition of plants.

As an absorbent of the rich gases, plaster acts as well on dry as on wet lands. Its virtues as an absorbent are, however, much more manifest when used in connection with ammoniacal manures. Indeed, one of the best modes of applying it is to sow it over land that has just been top-dressed with compost. Many prefer using it in the compost heap as it is shoveled over, or in the stables, where it prevents the escape of ammonia and keeps the air pure. On freshly plowed lands, especially when rich, plaster acts with great efficacy as an absorbent; and for the same reason, it should be freely sprinkled over the compost heap each time it is shoveled over. On newly stocked land, especially when stocked with clover, its efficiency is more manifest than on old mowing fields and pastures.

As an absorbent it also acts from year to year, and its effect is sometimes more apparent the second year than the first. We have found plaster to work admirably when applied to plants while the dew is still upon them in the morning, or after a shower, so that the plaster sticks to the leaves; and we prefer to use it as a top-dressing after the leaves have been pretty well developed. Others recommend using it on the late snows of March, that it may absorb the ammonia brought down in the snow. When lime and sulphur are deficient in the soil, plaster must be efficacious, as also where the rich gases are escaping into the air from the stable, compost heap, or the well-manured field. It must also greatly aid in retaining the ammonia brought down from the air by the dews and rains. Still, it can not be denied, that on some lands, and particularly those lying near the sea, the testimony is that it does no good, and every farmer should test for himself with close observation its effects upon his own soil, always remembering that plants can not live on plaster alone.

CHAPTER XVIII.

PHOSPHATE OF LIME.

THE mineral manure which of late years has claimed, and deservedly so, the attention of farmers, is phosphate of lime. The cattle that graze in our fields derive all the earthy matter, of which certain parts of their bodies consist, from the vegetables on which they feed. These vegetables, in their turn, must derive them from the soil. Phosphate of lime must, therefore, exist in the soil, or animals could have no bones, and where cattle husbandry is the leading object in agriculture, the probability is that the first mineral constituent that will be found wanting is bone-dust. Every ox sold from the farm carries off a large amount of this essential element of fertility, and it is estimated that the milk and veal sold from each cow on an average will make an annual draft on the farm for fifty pounds of phosphate of lime. Nor is the diminution much less on grain farms, for the ash of all the grains is composed largely of bone-earth, and with every hundred bushels of wheat sold from the farm sixty pounds of phosphate of lime must be deducted from its capital stock of fertility.

No wonder that in New England, where we formerly raised from twenty to thirty bushels of wheat on an acre, it is now difficult to obtain half this quantity; and that the wheat-growing region is fast receding towards the setting sun. The Genesee valley, which once boasted of its forty bushels of wheat to the acre, does not now average twenty.

There is no necessity for this deterioration of the soil, nor for the emigration which it causes from our exhausted lands to the virgin soil of the prairies. Old England sustains a much more dense population than New England, and raises more wheat to the acre now, in the middle of the nineteenth century, than she did at its beginning; and one reason is that she has imported from the plains of Waterloo and other localities abounding with bone-dust, all the phosphate of lime that could be scraped together. If the Thames did not carry to the sea so much of the fertilizing material of the metropolis of the world, England might sustain a far greater population than she does, with less importation of breadstuffs and guano.

Belgium and China also suffer no impoverishment of the soil. The former sustains the densest population in Europe, and the latter in Asia, by close husbandry of all the resources of fertility. China and Japan have been cultivated for long centuries, have imported no guano nor phosphates, and the land is as fertile to-day as it was a thousand years ago. The sewers of China do not carry to the sea all the phosphates that the grains furnish. The land is considered as having a rightful claim to all the manure, in every form, that the country can yield, and this is a just view of the case. It is a species of robbery to live on Mother Earth, and expect her to maintain us, without giving a full equivalent for our board. It is not necessary for us to descend to all the vulgar practices of the semi-civilized Chinese, but there are many lessons in the arts that we can learn from them, and in no art is their superiority more manifest than in that of agriculture, especially in the faithful return to the soil of all the phosphates it has yielded. China has comparatively few cattle to carry off these phosphates in their flesh and bones, and what the grains yield is not wasted by the common sewer.

The American farmer has flattered himself that he has done the land justice, when he has returned to the soil the manure obtained from feeding out the hay and other coarse products,—many have not even done this much,—while the manure afforded by the consumption of grain, far richer in ammonia and the salts of lime, has been much neglected. Besides the waste from the grains of home production, we import thousands upon thousands of barrels of flour and car-load after car-load of corn from the fertile prairies, and from a great share of this grain the land receives no benefit. From such a consumption of foreign products Massachusetts soil should be enriched, till all the arable land shall become as fertile as a garden. If Colonel Waring can succeed in popularizing his plan of "earth-closets," we shall hope to see some improvement in the preservation of the ammonia and the phosphates, which the consumption of so much wheat and corn must yield.

Bones are at present our great resource for replenishing the soil with the phosphates which the crops have carried off, and few substances have of late years done so much to increase the agricultural produce of England as the use of crushed bones. The quantity of earthy matter, chiefly phosphate of lime, is always great in bones, but varies with the species and age of the animal, and with different bones in the same animal. It is less in the young than in the mature animal; less in the spongy than in the compact bones. As the animal becomes old, the earthy matter in the bones again becomes less. The bones of a freshly slaughtered mature animal are composed of organic matter, chiefly fat and gelatine, varying from 40 to 50 per cent.; and inorganic matter, chiefly phosphate and carbonate of lime, varying from 50 to 60 per cent.

The practice of burning bones before they are used on the land is wasteful, as all this organic matter, rich in ammonia, thus passes into the air. When bones have been burned till every thing combustible has disappeared, what remains is chiefly phosphate of lime, composed of 51 1-2 per cent. of lime, and 48 1-2 of phosphoric acid. Mingled with this phosphate there is, however, some carbonate of lime and a little magnesia, soda and potash, all useful in the soil, but the main virtue lies in the phosphate.

Applied directly to the soil in an uncrushed state, bones are a long time in decomposing. When they are buried around the roots of trees and vines, they slowly decay and furnish nutriment for a long series of years. The vital energy of the roots probably acts upon the inert matter of the bones, and hastens the decomposition.

If we may credit the newspapers, the roots of an apple tree planted over the grave of Roger Williams were found a few years since to have penetrated his skull, followed the vertebræ of his back, with branches to the ribs, divided at his hips, pursued the bones of the legs to the feet, and branched off through the toes, so that the roots gave a pretty accurate outline of the skeleton of a man.

However this may be, we have experimented in placing bones at the roots of trees sufficiently to be convinced that they thus serve a most excellent purpose. Trees can afford to wait for the slow decomposition of bones, but in our cereal, grass and root crops we desire a more speedy action. This can only be obtained by some mode of pulverization, and he will be a public benefactor who will invent some cheap mode of grinding bones, so that every farmer, certainly every neighborhood, can manufacture bone-dust. There is so much adulteration in our commercial manures, that pure superphosphate is almost as difficult to be obtained as pure French brandy.

Pounding bones with a sledge-hammer, as we have seen some farmers do, is a slow, laborious process, and only half accomplishes the object. Finely pulverized bones will produce more effect in two years than these broken pieces will in ten. The general rule, applicable alike to bones and all other fertilizers, is, the finer the manure the more immediate is the action.

Liebig, Johnston, and other chemists, recommend the digestion of bones with sulphuric acid diluted with twice its weight of water. In pure phosphate of lime or bone-earth, we have 72 pounds of phosphoric acid united with 84 pounds of lime. By adding to this 80 pounds of sulphuric acid, the latter acid unites with 56 pounds of the lime, forming a sulphate of lime (common plaster), leaving only 28 pounds of lime in combination with the phosphoric acid. This combination forms biphosphate, or, as it is more commonly called, superphosphate of lime, which is soluble in water, and acts with great energy upon vegetation. The whole compound thus formed consists of 100 pounds of superphosphate and 136 pounds of plaster. As the superphosphate is soluble in water, it is not a lasting manure, but its great energy compensates in a measure for this, and if we could only be sure of purchasing the pure article, we know nothing that can give corn, wheat and the cereals generally a better start; but, unfortunately, under the term of superphosphate we have as many kinds of spurious manure as we have spurious kinds of freedom under the name of liberty.

Every farmer can manufacture his own superphosphate, and thus be sure of a genuine article; but as the handling of sulphuric acid is not always safe, we have preferred to dissolve our bones in wood ashes. If in a tight cask a layer of bones three or four inches in thickness be placed, and on these a layer of ashes of the same thickness, and so on in alternate layers, and the whole kept moist for six or eight months during warm weather, the bones will be found so dissolved that they will readily crush under the shovel. This compost may not act with all the energy of superphosphate, but it is a much more permanent manure, and can not fail of being beneficial on all soils and to all crops, as it contains all the mineral elements of plant-food.

The most economical mode of applying this compound of bones and ashes is to compost it with muck, as it hastens the decay of the vegetable matter by its catalytic and chemical influence, and the whole mass becomes one of the richest forms of manure, of which we may never fear our lands will become sick. By all means save the bones, and save them fresh with their sinews still upon them, for they can be made the bone and sinew of the land as they have been of the animal.

In some parts of the world a native phosphate of lime, called apatite, has been found in considerable quantities. It differs but slightly from the earth of bones in its composition, containing a little less phosphoric acid and two or three per cent. more of lime. It has been known and used in England for years, and has recently been found in large quantities near Charleston, in South Carolina. Inexhaustible stores of this mineral seem to be stored away in the soil between the Ashley and Cooper Rivers, and if it fulfils all it promises, this native phosphate may do for agriculture what the coal beds have done for manufactures.

CHAPTER XIX.

WOOD ASHES AS A MANURE.

WE have time to consider only one more mineral manure, and that is wood ashes, which we think have been generally undervalued, as they contain, not one or two elements of plants, but a dozen. We are apt to think of ashes as furnishing only potash, as this is the substance for which they were formerly mainly valued; but the ash of all plants consists of a mixture, in variable proportions, of carbonates, silicates, sulphates, and phosphates of potash, soda, lime and magnesia, with certain other substances in smaller quantity, but doubtless necessary to vegetable growth.

The analysis of the ash of red beech gives, for example, twelve different elements and compounds, as follows: Silica 5.52, alumina 2.33, oxide of iron 3.77, lime 25, magnesia 5, potash 22.11, soda 3.32, sulphuric acid 7.64, phosphoric acid 5.62, chlorine 1.84, oxide of manganese 3.85, carbonic acid 14. Such a combination of the mineral elements of plant-food we look for in vain in any other manure. Lime may fail of benefiting some soils; but we have never known wood ashes to be complained of as inefficient. They contain so many of the ingredients of plants that if the soil is lacking in any one element, they are very sure to supply it. They are as well adapted to supply the deficiencies in the soil as Brandreth's pills are to cure the ills of the body.

The ashes of different woods, grasses, roots and grains give different proportions of the above elements and compounds, but agree in giving nearly the same variety. Oak wood makes an ash that gives less potash than beech, and pine still less than oak. Turnips make an ash rich in phosphate of lime, and red clover ash abounds in sulphate of lime. Hence we see the propriety of the English practice of manuring turnips with wood ashes, mixed with bone-dust, and of the American practice of sowing plaster on red clover, as the ash of these crops shows that they require these specific manures. The ash of all leguminous plants, as peas and beans, as also the ash of potatoes, is rich in potash, and to these crops unleached ashes from hard woods should be applied.

Like other mineral manures, ashes are deficient in ammonia and carbonaceous matter, but as these are mostly derived from the air, some chemists have claimed that all that is requisite to maintain and increase the fertility of the soil is to furnish it with these mineral elements. We do not find it so in practice. Applied to poor, light, sandy soils they may produce great results for a year or two, but unless some carbonaceous and ammoniacal manure is furnished, exhaustion follows, and the last state of this land is worse than the first. The soil is rapidly deprived of its vegetable matter, and has little ability to absorb and retain the ammonia of the air. The mechanical effect of the carbonaceous manure is also wanted to render the soil porous, and good forage ground for the roots of plants; so that, highly as we value ashes, we can not recommend them as omnipotent in maintaining the fertility of the farm.

We have found it the most efficacious mode of using ashes to compost them with muck or leaf mold from the forest. In this way the decomposition of the muck or mold is hastened, and the supply of carbonaceous matter in the soil is kept up. A bushel of ashes with five or six bushels of muck will make a compost fitted for all soils, where vegetable or mineral matter is deficient, and there is no fear but that every crop the farmer raises will appreciate the rare combination of virtues found in such a compost. The ashes will furnish the mineral matter necessary for the skeleton of the plant, and the muck will aid in clothing this skeleton with carbon.

Some farmers may suppose that because so little ash is left when a plant is burned,—only a half per cent in case of wood, and two or three per cent in case of grain,—that the ash is of trifling consequence. They might as well suppose the bones of their body of small account. Weighed in the balances, the skeleton of the plant, like the skeleton of the animal, may not figure largely, but the value of an article can not be measured in avoirdupois. The brain weighs little in comparison with the whole body, but we do not esteem it the less highly on this account. The table salt that we eat constitutes a very small portion of our food, but it is none the less essential.

The salts of lime, potash, magnesia and soda must constitute the frame-work of our bodies, or we should be degraded to the level of slugs,—snails without a shell. All animals derive their frame-work originally from vegetables, and the vegetable must have it, or it can not impart it to the animal, indeed can not elevate itself from the ground.

Where ashes are scattered plentifully, every farmer must have noticed how much more erect and firm the straw of his wheat or oat field is. It does not "lodge," as the farmers' phrase is. The grains are equally benefited with the straw. They are larger, fuller, and richer in the elements of nutrition for animals. If we feed our soils richly with these inorganic elements, they will feed us richly.

We desire also to say a word for the much neglected and undervalued leached ashes. When our fathers cut down the primeval forests of Massachusetts, they felled the trees in rows, burned them, gathered up the ashes and leached them to extract the potash; that was exported, and the remainder was cast out as worthless. They seemed to think that potash was the only ingredient of ashes worth saving, and we have imbibed the prejudices and followed too closely the example of our fathers.

The truth is, only one of the many constituents of ashes is lost by leaching, and of this one, potash, only four-fifths are taken away in the common process of leaching, and one-fifth still remains for the benefit of the soil. The silicates, sulphates and carbonates are practically insoluble, and remain in their integrity after the leaching. Berthier found, on analyzing the ashes of beech wood that had been thoroughly leached by himself, the following ingredients: Silica, 5.8; lime, 42.6; magnesia, 7; oxide of iron, 1.5; oxide of manganese, 4.5; phosphoric acid, 5.7; carbonic acid, 32.9. It will be perceived that the phosphate of lime, one of the most valuable of the components of ashes for agricultural purposes, is not diminished, being insoluble. It is to these insoluble compounds that ashes are indebted for the permanent effects they are known to produce upon land. The potash and the soda may be pretty much used up the first year, but the phosphates, silicates and sulphates will last for an indefinite length of time.

We have known the land in the neighborhood of an old ashery to show the good effects of ashes for half a century after the potash kettle was removed; and we have questioned whether the lasting benefit of a coal-pit was due entirely to the refuse charcoal left behind. In burning the coal, more or less of the carbon must get so much air as to be consumed, and the ashes must be left, which, in combination with the almost imperishable charcoal, make a compost much like what we have recommended of ashes and muck, for muck and charcoal are only different forms of carbon. Unless the ashes have a part to play in the fertility of a coal-pit bed, we can not understand how the grass can flourish there for fifty years, and possibly a century, without exhausting the mineral elements of the soil. The charcoal may continue to absorb the enriching gases of the air, but the earthy materials, it would seem, would become exhausted.

Wood ashes have been sold in Massachusetts for from ten to twenty cents a bushel, and at this price we know of no manure better deserving the attention of the farmer. Leached ashes have of late years commanded half the price of unleached, and for agricultural purposes they are worth almost as much, as the potash is not wholly exhausted, and the phosphate of lime and other valuable salts are left in their integrity, only condensed into a narrower compass, so that in a bushel more is embraced. The small quantity of charcoal found in most ashes is not without its value, but the carbonaceous matter can be more cheaply furnished than by purchasing it by the bushel.

Another saline manure within the reach of most farmers, and still much neglected, is common salt. This is a compound of chlorine and sodium, both of which are elements necessary in all vegetation, and must be obtained from the soil. If the soil already contains a sufficiency of salt, or of chlorine and soda in any other form of combination, then an application of salt will do no good. Such are the lands that lie along the sea-coast, or are most exposed to prevailing sea winds. Over such districts the spray of the sea is borne by the winds, or is lifted high in the air and descends in the rains. Very contradictory statements are made by those who have experimented in the use of salt, some lauding, others condemning it. Such contradictions are easily accounted for, and should not deter inland farmers from further trial. Some crops require more salt than others, and we have no doubt that most of our inland farms would be benefited if the refuse brine, which is now poured out at the back door of the merchant as a nuisance, should be placed on the compost heap of the farmer. The fact that cattle are so greedy for a little salt with their forage proves that the crops do not contain enough to supply their demand. We need further experiments on this saline manure, and we commend it to the intelligence of Massachusetts farmers.

We have thus run over briefly the principal mineral manures within the reach of the farmer. The subject is one of paramount importance, and has been too much neglected. As surely as we are made of dust, and to dust must return, so surely we must be careful to return to the soil the dust or earthy matter which we subtract from it in our crops, if we desire to transmit to our posterity, with unimpaired fertility, the lands we have inherited from our fathers.

LECTURE SIXTH.

CHAPTER XX.

MANURES, VEGETABLE AND ANIMAL.

IN pursuing the subject of manures, we come to consider those that are mostly of a vegetable nature; we say mostly, for no vegetable grows that has not mineral elements in its composition. Too much importance can not be attached to the necessity of restoring to the soil, in some form, all that the soil gives us. In a state of nature, under the direction of the Great Husbandman, this restoration is fully made; and by the decay of vegetation on the surface of the earth, the soil is constantly ameliorated. Under the care of man, the crops are removed for the purpose of feeding man and beast, and the soil is consequently impoverished.

Nature's mode of enriching the earth is manifestly by restoring the vegetable matter directly to the soil, without passing it through the animal economy, whereby a large portion of it is converted into bones, muscles, hair, etc. If only the excrement is returned to the soil, there must necessarily be a loss of fertility to the extent of that which goes to the support of the animal.

What the land loses, however, the animal gains, and as we can not cultivate the soil with a sole reference to its fertility, but must live upon the crops we raise, we have long been convinced that there is a more excellent way of maintaining the productiveness of a farm than by plowing in the green herbage. This may answer in rare instances, where the soil is extremely poor, or located at such a distance from the barn-yard that the carting of manure upon it is expensive; but to do it as a general rule would be like a bank's adding all its profits to the capital stock, and making no dividends. Few farmers can live without their annual dividends from their lands.

By green manuring is meant the growing of crops and plowing them in while in a green state, for the improvement of the land. This is not, as some suppose, a modern practice. Both the Greeks and Romans were well acquainted with it, and it is not unlikely that it was practiced by more ancient nations, as it is a mode easily learned from nature, and one better adapted to an early than to an advanced civilization. The Belgians have done the most of any modern nation in enriching their soil by plowing in green crops, and they have certainly been very successful in bringing their lands to a high state of fertility.

Some may question how land can be increased in fertility by merely restoring its own products, but we must remember that the atmosphere is the great reservoir from which the plant draws its carbonaceous matter, and if this is plowed into sandy fields, such as the plains of Flanders originally were, they can in time be converted into a fertile loam. The roots of some plants also extend to a great depth, and bring up from thence mineral elements to enrich the surface and furnish a good bed in which other plants, whose roots are less roving, can luxuriate. There can, therefore, be no question but that green manuring enriches the soil. The only question is one of economy.

We have no doubt that on sandy lands, remote from ordinary resources for manure, there is no more convenient mode of restoring fertility than by sowing some broad-leaved plant, which will draw largely from the atmosphere, and, when the herbage has attained its full growth and before the seed has developed, plowing it under. The two crops most commonly used as green manure, in this country, are red clover and buckwheat.

The former has numerous stems, broad, succulent leaves, and long, thick tap-roots, and where the soil is strong enough to produce it, or can be made strong enough by the application of plaster or ashes, clover is probably the best crop for green manuring that can be raised. Its tap-root is especially valuable, as it penetrates the subsoil and brings up the saline matters, which are thus made available for the succeeding grain crops. If clover can be made to grow on land, there is no fear but that other crops can be made to succeed it. It is estimated that the clover roots and leaves grown on an acre, will furnish from five to seven tons of vegetable matter, and impart to the soil as much strength as ten or twelve loads of barn-yard manure.

The land is made mellow and permeable to heat and air, not only by the decay of the vegetable matter plowed under, but the long roots, as they perish, must render the subsoil more porous. Practice fully confirms this theory, as corn, oats and wheat, are uniformly productive on a clover ley. Whether it may not be more economical to mow the first crop of clover and plow in the second, or feed both crops to cattle and return the manure to the land, each farmer must judge from the circumstances of his situation. If the land is near the barn, we should certainly feed the clover to the cattle, and feed the land in some other way.

Where it is desired to eradicate weeds or thistles from the soil, as well as increase the fertility of the land, we know of no crop equal to buckwheat. It requires but little seed, as its stems branch in every direction ; it grows rapidly where corn would starve, and quickly shades the ground so as to smother all other vegetation. If sown early, two crops can be grown in one season, and the three plowings which the two crops involve, together with the vegetable matter turned under, render the land exceedingly friable and mellow.

In the western part of this State, we have much poor land, overgrown with what is locally known as hardhack (*potentilla*), a low bush fit only for barn brooms, and very difficult of eradication; but if the hardhacks are not so thick that the land can not be plowed, we have never known buckwheat to fail in coming off victorious in a contest with them.

The Canada thistle, another thief, that steals the fatness of the land and is armed with many lancelets, can not stand its ground in a fair fight with buckwheat. It may renew the strife after one or two defeats, but is sure to succumb finally. Buckwheat derives more nourishment from the air, and makes less draft on the mineral elements of the subsoil, than clover, and which of these two crops to select as a green manure, must be decided by the nature of the soil to be benefited. We have found succeeding crops to do much better after clover than after buckwheat, but as an eradicator of interloping weeds, buckwheat is the champion crop.

We have, however, other fertilizing vegetable substances,—and most farmers have them in abundance,—the use of which does not involve the loss of one year's crop. The first we will mention is the leaves of trees. It is by the aid of leaves, mainly, that our forests are annually enriched, so that in the course of thirty or forty years an acre of poor land, planted with forest trees, will yield fifty or sixty tons of wood (mostly carbon), and when the wood is cut off, the soil is found rich in carbonaceous and saline matter—in fact, restored to a state of virgin fertility.

We should consider this result almost miraculous, did we not see the process constantly going on in our forests. It is no miracle in the theological sense of the word, as it is no contravention of the laws of nature, but is brought about by the ceaseless action of the thousands of pores in each of the ten thousand leaves on the tree, which are continually during the day absorbing the carbonic acid from the air, retaining the carbon and throwing off the oxygen.

During the night this process is reversed, and the air becomes less vitalized with oxygen, but as the day is much longer than the night during the season of vegetable growth, there is a large accumulation of carbon, and it is from the air it is mainly derived. At the same time, the rootlets, little microscopic hairs, are sucking in the mineral elements from the depths of the soil in a soluble state. The number and ceaseless activity of the pores of the leaves is wonderful. On a single square inch of a lilac leaf, one hundred and twenty thousand pores have been counted, and the rapidity with which they act is so great, that a current of air passing over the leaves of a healthy growing tree is almost immediately deprived by them of the carbonic acid it contains.

These pores also absorb ammonia and other gases, as is manifest from the fact that the air surcharged with ammonia from a dead animal, when passed through a tree with dense leaves, comes out sweet and fit for respiration. The carbonic acid and ammonia, though death to the animal when inhaled into the lungs, is life to the plant when absorbed through the pores of the leaves.

We are greatly mistaken if the part that the leaves take in restoring fertility to the soil has not been undervalued. We are apt to look upon them in the autumn as a nuisance, as they lie withered and strewn about our fields, but the sere and yellow leaf, when dead, has as important an office to perform for the soil, as it had when alive for the tree.

A little dry leaf is an insignificant matter, and as we crush it in our hand it amounts to but little, but "many a little makes a mickle," as the Scotch proverb has it, and so found the Scotch nobleman, the late Duke of Athol, who planted the poor, hilly soil of his estate with the larch, and in thirty years found his land increased in value tenfold. Leaves are rich, not only in organic matter which they have derived from the air, but the roots of the trees, in grateful return for the elaboration of the sap performed by the leaves, furnish them a bountiful supply of inorganic matter, varying in kind and quantity with the different varieties of the trees. Thus the dry leaves of the oak furnish, by analysis, five per cent. of earthy matter; beech, seven; willow, eight and a half; and elm, eleven and three-fourths.

No wonder that leaf mold from the forests is sought for by horticulturists and florists as just the soil in which their plants find abundant nourishment and grow luxuriantly. Every farmer, who has a forest near his barn-yard, has a mine of wealth for his farm. No better material can be found for the basis of his compost heap. Being composed chiefly of carbonaceous matter, it is a great absorbent of the gases of the manure; the fermentation of the latter hastens the decomposition of the whole, and the mass soon becomes fit food for plants, and the manure of the farm doubled in value.

The objection may be made, that in taking the leaf mold from the forests to enrich the tillage ground, we are robbing Peter to pay Paul, but there is no jealousy between the forest and the meadow. They belong to the same farm, and both are willing to labor for the enrichment of the owner. So rapid is the accumulation of vegetable matter in a forest, that the trees will scarcely miss what the farmer may take.

Of little less value are the leaves which lie around our yards and lawns. If left to perish where they fall, they are a nuisance, covering and sometimes smothering the green turf. We should decidedly object to raking the leaves from under the trees of the orchard, for here they are performing an important part in the economy of nature. If we take the apples from the orchard, we should certainly let the leaves remain for the nourishment of the trees; but the premises around the house are sacred to neatness and a velvety turf, and here the leaves should be carefully raked up, and used primarily as bedding for horses and cattle, and finally as manure. Whoever thus uses them will find a double advantage, and we are glad to notice that their value is more and more appreciated, both as bedding and manure. Whoever tries them once will not fail to try them again, and continuously.

Very analogous to the leaves of our forest trees is seaweed, which is still richer in inorganic matter. We have remarked that the ash left by leaves varies from 5 to 12 per cent., but the ash of some of the sea-weeds amounts to 16 per cent., and is remarkable as containing more gypsum and soda and less potash, than leaves. Sea-weeds also decay much more rapidly than clover and buckwheat. When used as a top-dressing, they wither, and in a short time almost entirely disappear. When placed in the compost heap, which is their proper position, they speedily decompose and little trace of the plants can be perceived.

It is of importance to notice that in using leaves and sea-weed, we make a positive addition to the arable land, of saline and organic matter, but in plowing in a green crop, we only restore the saline matter which the plants have already taken from the same ground. In using sea-weed, we bring back from the sea a portion of what the rivers are constantly carrying into it. A farm on the sea-shore has this great advantage over one in the interior, and those sea-board farmers are wise who avail themselves of all the sea-weed which the waves may wash upon the beach. Those of us, however, who live in the interior, are not wholly destitute of resources for vegetable manure, without resorting to plowing in green crops. The blessings of Providence are more evenly distributed than we sometimes imagine.

CHAPTER XXI.

MUCK BEDS AND THEIR VALUE.

IN the muck beds, which are found in almost every town, and, indeed, upon almost every farm in Massachusetts, there are reservoirs of manure which this generation can not exhaust. A farmer in Berkshire recently remarked to me, "I have at least a million of loads of muck on my farm." These muck beds seem reserved by a kind Providence to furnish manure for the exhausted fields, as the coal beds have been reserved to furnish fuel for our houses and manufactories.

I have already spoken of the formation of these muck beds, while treating of the origin of soils.

Sacred history and science concur in affirming that there was a time, far back in the ages, when no vegetable matter existed on the earth's surface. The first low order of plants must have been nourished from the air, without the aid of either animal or vegetable matter. Many seeds will now germinate and grow in soil, in which no trace of vegetable matter can be found, if they are only furnished with water and air. Beans sown in pounded flintstone will double their weight of carbon. These are facts which we can not deny; still, the principle remains that that soil is best, other things being equal, in which carbonaceous matter abounds.

When an impoverished soil is laid down to grass and lies undisturbed for a series of years, the vegetable matter accumulates, and when it is broken up we find a black, fertile mould, ready to yield remunerative returns of any crop we please to put upon it. A seed germinates in a soil in which there is no vegetable matter, grows vigorously at first at the expense of the air, but soon shows the want of more nourishment at the root, and dies, stunted or immature. In its death it imparts to the soil the carbon which it had derived from the air, and its successor finds a better soil. If the land is warm and sandy, the decay is rapid, and little of the carbonaceous matter is retained in it.

This is the kind of land which is most benefited by a supply of muck from the swamp, where the decay has been slow, owing to the exclusion of air and heat by the excessive moisture. On clay soils, also, muck operates mechanically to great advantage in rendering it more light and friable. It is less than half a century since our muck swamps were considered a nuisance, a fertile source of miasma, and fit only for the abode of frogs. Now these swamps are treasured as the most valuable part of the farm, as they furnish the basis for the enrichment of the whole.

The value of muck differs in different locations; depending partly on the stage of decay in which it is found, and partly on the substances from which it was originally formed. When applied directly from the swamp to the arable land, it is cold and sour, decays slowly, and the benefit is not immediately apparent, so that many who have tried it in this manner have denounced it as worthless. Others have placed it upon cold, wet land, already abounding in vegetable matter, and have thus carried coals to Newcastle.

That it will enrich all dry soils, deficient in carbonaceous matter, there can be no question. It may not show much virtue the first year, unless it has been previously composted with some nitrogenous or alkaline manure, by which its decomposition has been hastened, or its acidity neutralized; but like the beds on which coal-pits have been burned, its effect will be found permanent. We speak after an experience of twenty-five years in using it, and feel confident of what we affirm. If muck is lifted from its wet bed and exposed merely to the air, it will in a year or two become dry and sweet, and by its absorption of gases be rendered a valuable manure.

But a better mode is to use it as an absorbent in the barn-yard and piggery, and as the basis of the compost heap. No definite rule can be laid down for the proportions in which to compost muck and barn-yard manure, as the latter varies so greatly in quality; but it may be stated generally that one part of manure and two parts of muck, well shoveled and mixed, will make a mass worth twice as much as the manure alone.

In speaking of the inorganic manures, we alluded to the great virtues of wood ashes, especially when combined with the organic matter which muck furnishes; and we can not forbear, in this connection, repeating and enforcing this idea. On muck alone, few plants thrive and come to maturity. On a pure muck heap, corn will not grow a foot high, because earthy matter is deficient; neither will corn grow upon an ash heap. All the salts requisite for its growth are present in such a heap in excess, but there is no organic matter, and consequently little ammonia. Mix the ashes and muck, and the deficiencies of the one are supplied by the other, and we know of no compost in which we are more certain of finding the varied food which most plants demand. It has also the great merit of being speedily ready for use. A bushel of ashes well incorporated with five bushels of muck will, in a fortnight, be equal to most well-rotted barn-yard manure.

As an absorbent, dry muck is very nearly equal to pulverized charcoal, which it much resembles also in its chemical constitution. As a basis of compost, we know nothing superior to it, unless it is leaf mould from the forest, which is richer in potash and other soluble saline matters. We can not too strongly insist upon the importance of composting all manure. Not only is the quantity greatly increased, but the quality is also. Much of the barn-yard manure that is carted directly from the yard and plowed under, is unevenly distributed, is full of seeds, and lies in large lumps, so that the crops do not receive the full benefit of it. By composting, we not only get a much finer manure, but we also get the mysterious catalytic influence, by which, in the contact of fermenting nitrogenous substances, the whole mass is fermented, much in the same manner as when, by a little leaven, the whole lump of meal is leavened. We know that there is labor in composting, and that labor costs money; but we very much question whether any labor on the farm is more economically expended than upon the compost heap.

Barn-yard manure is not the the only substance which can be composted with muck. Anything which undergoes rapid, spontaneous decomposition will infect the muck with the same tendency to decay, and will render it capable of ministering to the growth of cultivated plants. A dead horse of the ordinary size will convert four or five cords of muck into good manure, and not a particle of the ammonia need pass off to pollute the air and rob the soil. The refuse of our manufacturing establishments affords much excellent material for the compost heap. Shoddy can not be put to a better use. Woolen rags, the sweepings of our woolen mills, the refuse of our tanneries and paper mills, when mingled with muck, will heat the whole mass, and produce rapid fermentation and decay. For many years past we have used the refuse sizing of a paper mill, consisting of the skin of animals from which the glue had been extracted for filling the pores of writing paper. So great is the tendency of these moist pieces of skin to decay, that the air for half a mile to the leeward of a pile of them is filled with ammonia, but buried under muck the odor is all absorbed and retained for the benefit of the land. The muck also speedily partakes of the tendency to decomposition, and even the hair on the skins, one of the most indestructible of animal substances, can not resist the decomposing influence of the fermenting pile.

Very similar to this influence of sizing upon muck is the effect of the refuse shoddy of a woolen mill. Wool is much slower of decay than skin, but, being mixed with oil, the oxygen of the air unites with the carbon of the oil, producing heat, sometimes resulting in spontaneous combustion. When this shoddy is mixed with muck, the heat of the pile often rises to 100 degrees, and rapid fermentation and decay are the consequence. Leather parings, being filled with tannin, which closes the pores and resists the action of air and water in ordinary circumstances, show evident tendency to decomposition when placed in a warm, fermenting compost heap.

Lime also acts most favorably on muck, hastening its tendency to decomposition, and rectifying its acidity. It should, however, be used with caution in a compost with nitrogenous subtances, as the ammonia will escape unless the pile is well covered with muck, which will absorb the gas as it is set free. With this caution, we are confident lime is an efficient adjunct in the compost, both benefiting and being benefited, for in no way can lime be applied to the soil so beneficially as in conjunction with vegetable matter. The greater the variety of elements introduced into the compost, the more efficient it will prove, for one of the greatest mistakes of farming has been the endeavor to feed crops with one variety of food.

All special manuring must sooner or later prove a failure. It may answer for a time, just so long as the one or two elements of plant-food which it supplies are the only elements in which the soil is deficient, but the increased draft which the crops make on the others will soon cause their exhaustion. Everything about the premises which can furnish plant-food, should be carefully husbanded. The slops of the house, the contents of the cess-pool, the soap-suds of the laundry, can in no way be disposed of so healthfully and so economically as by being composted with muck, or, where this is not convenient, with turf rich in vegetable matter. Everything that has once lived can be made to live again. The round from death to life and life to death is ceaseless. Man has no power over the issues of life. They come directly from the Creator, but we can determine what shape the new life shall take. The weeds that deface and rob the soil can be converted into potatoes, corn, or wheat, at the option of the farmer, or by his neglect can be left to go to seed and produce after their kind, some thirty, some sixty, and some an hundred fold.

Chip manure is very analogous to muck in its composition, and should be treated much in the same manner. We have seen in some wood-houses,—contiguous to the kitchen, too,—the accumulations for years of chip dirt, slowly rotting, and giving to the air a musty smell. We should dislike to inhale into our lungs the seeds of mold which must emanate from such a decaying mass. The wood-house should annually be cleaned out, and the waste put upon the compost heap, both from regard to the health of the family and the enrichment of the farm. Mixed with the rapidly decaying matter of the compost, the rotten chips will soon become fertilizing mold, and if a little fresh slaked lime is sprinkled in the wood-house after the chips are removed, the air of the house will be sweeter, and possibly disease averted from the household. We have known instances, and not a few of them, where the chip manure is dumped into the street. This shows lamentable ignorance, both of what constitutes good road material and good farming. Indeed, by far too many of the roads of Massachusetts are built of sods and mucky soil, excellent for the growth of potatoes, but execrable for a road-bed. Vegetable matter makes a light, porous, loamy soil, but can not make a hard road. There are other sources of vegetable manure, such as saw-dust, tanner's bark, etc. Spent bark is very slow in decomposing, but placed in the compost with the lime, hair, and other refuse of the tannery, it will eventually become good manure. No organic matter must be neglected by the intelligent farmer. If it has once lived, it will surely live again, and it is the farmer's province to direct the molding of the new life.

But we must hasten to the consideration of animal manures, including the excrements, and the bodies of animals. The great resource of the farmer for manure is the barn-yard. Few farmers of the eastern or middle States fail to appreciate the importance of feeding out all

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the hay and coarse fodder, and returning its results for the benefit of the growing crops. On the western prairies, we have seen the stacks of straw burned to get them out of the way, and the piles of manure around the barns lying neglected. At the East we sometimes see bad management of the barn-yard manure, but never total neglect of it; and the time will come when our western friends will regret firing their straw stacks, and the equally wasteful practice of firing the grass on the prairies. The ashes that are left will do some good, but not a tithe of what might be received from the organic and inorganic matter co-operating.

CHAPTER XXII.

ANIMAL MANURES.

BARN-YARD manure, derived as it is from the crops of the farm, contains all the elements which these crops need, and never fails of answering a good purpose. Lime, plaster, and even bone-dust may sometimes prove inoperative, as the soil may already contain a sufficiency of the elements which these special manures furnish ; but we have yet to see any long cultivated land to which the application of barn-yard manure was not grateful. A manure is useful to vegetation by affording, in its decomposed state, direct food, or by adding to the soil additional power to absorb and retain atmospheric gases. Barn-yard manure acts in both these ways. It contains all the inorganic food that plants need, and at the same time its bulky carbonaceous matter retains the ammonia derived from the decaying tissues of the animal, and also renders the soil porous, ready to absorb still further supplies of the gases of the air.

The question has been asked, why does the hay, which seems so indestructible in the mow, undergo such rapid putrefactive fermentation after it has passed through the animal, and why, if the animal extracts from the hay a good share of its nutriment, would it not be a more rapid and economical mode of enriching the farm to plow in the forage without feeding it to the animal, so that all its virtues may be returned to the soil?

The answer obviously is, that the hay, as it passes through the animal, is composted, as it were, that is, it is moistened with the saliva, warmed by the animal heat, and receives a portion of the waste of the body which is continually passing off, so that if the animal is not growing or furnishing milk, nearly as much fertilizing matter is voided as is consumed. Some of the nutritive elements of the food do indeed pass off through the lungs and skin, but this waste is more than compensated by the rapid decomposition of the forage in the animal, by which it is immediately rendered available again as plant-food; whereas if it was plowed in, the decay would be much slower.

It may be difficult to figure the exact gains and losses which the food undergoes in passing through the animal, but that it gains as well as loses there can be no doubt; and there is as little doubt that the farm on which cattle are kept to consume all the forage is most likely to be a rich one, and that cattle husbandry, judiciously managed, is the most profitable branch of farming,—profitable not only because the farmer is enriched, but because the land is most likely to be kept in good heart. If we see a barn well stocked with cattle, and the barn cellar and yard well filled with manure, we expect to see good crops in the field as surely as we expect when we sow wheat to harvest wheat.

Some farmers seem to suppose that it makes no difference to what stock their forage is fed, and that their farms can be sustained as well by one kind of stock as another. This is not so. The manure of young, growing stock is by no means as valuable as that from mature animals, as more of the food goes to building up the body of the animal. Just so with cows giving milk; much of the nutriment flows to the milk, and consequently flows off the farm. This may be no loss to the farmer, but the farm must be minus all the salts which the milk contains. Probably no stock returns so much to the farm as mature cattle that are being fattened, and none other ever should be.

The quality of the manure depends much on the quality of the food the animal consumes. Grain-fed animals give a much richer manure than grass-fed, and those that ruminate digest their food more thoroughly and extract more nourishment from it than those furnished with only one stomach. A pig may live on the excrement of a horse, but would starve on the excrement of a cow. The food of the bipeds is much richer than that of the quadrupeds, and their manure is correspondingly more valuable. Our barn-door fowls are great consumers of grain and meat, and the hennery can be made a manufactory of domestic guano little inferior to that imported from Peru. Both the domestic and imported guano are the droppings of birds, but as the Peruvian guano comes from birds that feed mainly on fish, it is richer in ammonia than that from our domestic fowls. Blessings are valued sometimes in proportion to the distance from whence they are brought. While we pay three or four cents a pound for the guano imported from the Pacific, we overlook or greatly undervalue that manufactured in the hennery. If this were all carefully saved and composted, as it should be, the quantity of good manure furnished by a flock of twenty hens would surprise the inexperienced owner.

The fertilizing power of domestic guano is partly due to the fact that the liquid and solid excrements are voided together.

The hennery should be kept well littered with muck or good loam, with a sprinkling of plaster, or leached ashes occasionally, and the manure furnished will be quadrupled in amount and value. Whoever shovels it over, even when thus diluted, will find the hartshorn escaping in such abundance as to be convinced that the absorbents are not in excess. The solid part of the droppings of birds, when recent, consists of a variable percentage of urate of ammonia, phosphate of lime, and other saline compounds. The liquid part, like other liquid manures, contains much urea, with some phosphates, sulphates and chlorides. If allowed to remain exposed to the air for much length of time, the salts of ammonia gradually volatilize, and the efficacy of the manure is greatly diminished. We have found the dry droppings of both pigeons and hens filled with worms, which were reveling on what should have constituted the food of plants. Hence the necessity of keeping the hennery well littered with some absorbent, or of frequently removing its contents to the compost heap.

We do not subscribe to the doctrine that the value of manure can be tested by the percentage of ammonia it contains, for, thus tested, ashes and all mineral manures would be ranked at zero; still there can be no doubt that ammonia is one of the most valuable fertilizers, and its careful preservation can not be too urgently insisted upon. In the excrement of fowls there is little carbonaceous matter to retain the ammonia, and hence the greater necessity of speedily composting it. It is also a too highly concentrated manure to be applied directly to the plant, but if properly composted, it gives corn and other grains a wonderful impulse. We have greatly undervalued in this country our domestic guano, and the price per bushel for the manure of the hennery has been about the same as the Belgians and Spaniards pay for it per pound.

Of all animals, man is the most richly fed, and night-soil is the most valuable of all the solid animal manures. Partly from ignorance of its value and partly from prejudice, it has never received that attention in this country which its merits deserve. By most families it is considered a nuisance, to be abated as best it may, often by a bonus to any one who will remove it; but it is one of those fragments that should be gathered, if we desire that nothing be lost. We carefully save the excrements of our quadrupeds, as we know that what has fed our stock must be returned to the land to feed the growing crop, or farm and farmer will alike be impoverished; but the richer deposit of the vault is neglected, and the aggregate waste is immense.

No manure we have ever tried is at once so cheap and rich as night-soil. Its value depends somewhat upon the quality of food consumed by the family. The greater the amount of animal food used, the richer is the night-soil. In the vault is found fecal matter derived from beef, pork, fish, butter, flour and eggs, and it must necessarily contain the elements requisite to reproduce the plants from which this rich food has been directly or indirectly derived.

Thousands and tens of thousands of barrels of flour are yearly imported into Massachusetts, and her soil should be enriched from the fecal matter derived from the consumption of so much grain. The rich pastures of Kentucky, and the prairies of Texas and Illinois, are constantly furnishing us droves of fat cattle, and the consumption of this vast amount of foreign beef should make our fields as green as those of the Emerald Isle; and they would do so, if night-soil were duly valued, and the proper means taken for its preservation and restoration to the land.

Johnston says dry night-soil is equal to thirty times its bulk of horse manure.

We have had much experience with it for many years, and from no manure have we derived so satisfactory results. Living near a populous village, we have had an opportunity to obtain an abundance, and have not been slow to improve the privilege. Like the manure of the hennery, it is rich in ammonia, and there is great waste of this gas, unless constantly covered with some absorbent.

True economy demands that night-soil should be composted before being applied to the land. Five parts of muck, loam or leaf mould to one of night-soil, will make a compost which will cover six times the space and do three times the good of the unadulterated article. We do not like to recommend the adulteration of manures, lest the term be misunderstood or perverted, but all the concentrated ammoniacal manures will act more efficiently and permanently if used in connection with some absorbent.

A dead horse contains ammonia enough to enrich half an acre of land, but if left to decompose uncovered, the ammonia passes off to a neighboring farm, possibly to a neighboring town or State, and only a square rod or two, where the horse lies, receives the benefit; and this little spot is so enriched that, like a plethoric rich man, it does not know what to do with its superabundant riches, and so it does nothing. Just so with night-soil; it amounts to but little when used uncomposted, and both for health and fertility, the composting should be attended to daily. While the vault may be made a prolific source of fertility by proper attention, it is also, when neglected, the source of disease and death. It is only one of the many instances in which what is life to the plant is death to the animal. Let no one neglect the vault for the want of a proper composting material. Any loam in which organic matter abounds will answer a good purpose.

The composting material which Rev. Henry Moule of Fordington, England, the inventor of the earth closets, recommends, is simply sifted dry earth. Col. Waring of Newport, R. I., to whom we are indebted for bringing these earth closets to the attention of the American public, says that just as he commenced writing his pamphlet on this subject:—"Every person sleeping on the second floor of the house was attacked with symptoms of fever. My house stands on one of the healthiest sites of this healthiest of all towns, and there is nothing in the soil or in the neighborhood to which any malarious influence can be attributed; but standing within ten feet of the house, on the side from which the wind generally blows, there was a common deep vault privy, which had also been a receptacle for the slops of the house. I immediately caused the vault to be cleaned out and filled up with earth, and its contents to be composted with earth, the whole vicinity being covered with air-slaked lime. Attending this disinfection there was a rapid convalescence of the whole household, equal to the effect of a removal to the mountains. I have no question that the putrefying contents of this vault were the direct cause of the disease, and that the removal of the cause led to speedy recovery."

We make this extract from Col. Waring's pamphlet to enforce a greater attention to the family vault from a regard to health, if no reference is had to the fertility of the soil. We have known similar instances in our own experience, and that terrible scourge of New England, typhoid fever, often visits families, and the cause is looked for in some distant marsh, or complainingly attributed to a mysterious Providence, when the cause really existed in the house, and the fault lay in the ignorance or inattention of the major-domo. Either the sanitary or the agricultural reason is sufficient to induce greater attention to night-soil. The industrial interests of the State are suffering from the neglect of the most important elements of fertility. Our present practice of hurrying to the sea, or burying in under-ground vaults, or in some other way putting out of sight and out of reach our night-soil, is diminishing the wealth of the country by millions. The French and Belgians are the only European nations that treat this fruitful source of fertility with anything like economy. Rev. Henry Colman, in his Continental Agriculture, published twenty years since, gave a minute account of the inoffensive way in which the night-soil of Paris was disposed of, returned to the soil, and reconverted into wheat and luscious fruits ; but still the common sewers of most cities are permitted to return to the sea the residuary products of millions of acres of land. It is singular to notice the slow progress of improvement in husbanding the resources of fertility, and the obstinacy with which men cling to old customs, however ruinous to the individual and the nation. Ever since the Cloaca Maxima was built, by which the entire sewerage of Rome was washed into the Tiber, and which Liebig asserts sapped the foundations of prosperity in the Roman empire, the fashion has been to rush all human excrement in cities and large towns into the sea. It is calculated that the Thames annually carries off from the city of London refuse sufficient to fertilize a million of acres of land; 130,000 tons of rich matter daily flow through the sewers. If Mr. Moule's invention of earth closets will prevent this waste, he will do England and America a service that will lay the foundations, so far as physical culture is concerned, of a Paradise restored. The main benefits of Mr. Moule's method may be secured in the country by every farmer's keeping a barrel of charcoal, or dry muck, or even a pile of dry loam near his vault, and daily throwing in a sufficiency to absorb all the volatile matter.

A prejudice exists in the minds of some against the use of night-soil, and a fear prevails that its presence may taint the growing crop. Nature's laboratory is too skillfully managed to give any occasion for such an apprehension. Look at any compost heap, made up of the most offensive substances which can be congregated together, and presenting a mass of objects disgusting to the touch, sight and smell. Yet this is the food of the vegetable world. The more disgusting it is to the animal, the more it is relished by the vegetable. Placed in the soil, the living plant separates and sublimates the particles with a skill which distances all science, and returns them to us, glowing with life, beauty and fragrance.

This resurrection of these vile particles, so purified, is analogous to the resurrection of which Paul speaks: "It is sown a natural body, it is raised a spiritual body; it is sown in weakness, it is raised in power." We must remember that our bodies, so fearfully and wonderfully made,—the wine which maketh the heart of man glad,—the flowers of the most exquisite coloring, beauty, and perfume, the fruits most luscious to the taste, all depend for their sustenance upon the fields made fertile by the vile compounds of the compost heap.

The over-refined and sensitive boarding-school girl, polished down till there is little strength left, may scorn the idea that her immaculate body is composed of the same elements that one day were in the compost, the next day in the grass, and the following day in the ox which grazed in the field, but the farmer must think of and understand these things, and standing in his barn-yard must know and rejoice to say: "Here is the source of my wealth; that which has fed my cattle shall now feed my crops; that which has given fatness to my flocks shall now give fatness to my fields."

We have never felt so rich, nor more impressed with the goodness and wisdom of Providence, than when shoveling over the compost heap. A mysterious power is ever operating in every department of nature, but a farmer, handling his manure, feels like a merchant taking an account of his stock in trade and finding his capital increasing, and must acknowledge that there is a power higher than man's, that can create life and beauty from the corrupt mass before him. Manure is emphatically the farmer's raw material, and the soil is the manufactory where this raw material is converted into salable goods, but there is a skill displayed in the manufacture which no mechanic can imitate. If an undevout astronomer is mad, an atheistic farmer must be as irrational as the ox he drives.

CHAPTER XXIII.

ANIMAL SUBSTANCES DECOMPOSED.

NOT only must all the vegetable matter of the farm and the excrement of the animals be carefully husbanded, if we would see the farm enriched, but the refuse animal matter itself must be treasured and restored to the soil from which it has drawn its life. It is in the animal that we find enriching material in its most concentrated form. Some may suppose the amount is so small as not to be deserving of the farmer's attention. Let such consider the infinite number and variety of animals on the face of the earth. The air, the earth and the water teem with animal life. The soil feeds the plant, the plant feeds the animal, and the animal, when dead, should return to mother earth the elements originally derived from her. This he does do, but not always in the place and manner to serve man's highest interest. We have seen the dead lamb hung on the limbs of a tree to scatter its enriching material wherever the winds pleased to blow, and the dead horse buried in some remote corner merely to suppress the effluvia, and with no consideration of the enriching material thus thrown away.

The flesh of animals is not only a rich manure in itself, but the rapidity with which it undergoes decay enables it speedily to bring other organic substances with which it may be mixed, into active fermentation. The composition of dried flesh is in 100 parts, carbon 52, hydrogen 8, nitrogen 15, oxygen 21, ash 4. The flesh of animals consists of a lean part, called by chemists fibrin, and a fatty part, intermixed with the lean in a greater or less proportion, according to the condition of the animal. Of these it is the lean part which is nitrogenous, and acts most energetically in the promotion of vegetation.

Blood is very analogous to beef in its composition, but contains more water, and makes rich compost, decomposing still more readily than flesh. In some parts of Europe it is dried and ground, and in the state of dry powder is applied with great advantage to the crops. Wool, hair and horns differ from flesh and blood in containing but little water, and consequently decay much more slowly. In chemical composition, they differ but slightly from each other, and from flesh and blood, and are rich in nitrogen and other elements of plant-food. Woolen rags are so highly valued by the hop-growers of England that they pay from $20 to $40 a ton for them to bury around the roots of the vines, to which they continue to furnish nutriment for a long time.

Horn, in the form of horn shavings, parings and turnings, is justly considered a powerful manure. Horn, however, decomposes slowly when applied directly to the soil. The decomposition may be hastened by placing the horns in contact with fermenting manure in the compost heap. We have used the horn piths with great benefit. These decompose more readily than the horns themselves, and may be bought at the tanners at a low rate. One of the best applications of horns, hair and bones, is to bury them under vines and fruit trees, placing sufficient dirt over them to furnish a mellow bed for the roots to rest upon.

Farmers on some parts of the sea-coast have a great resource for manure in fish, which are often met with in such abundance that they can be economically used for fertilizing the land. They are either spread upon the land and plowed in, or what is far better, composted. Both the flesh and bones of fish are nearly identical in chemical composition with the flesh and bones of land animals, though fish furnish a little less nitrogen. If the quantity of nitrogen is the standard of value in nitrogenous manures, as some affirm, it is easy to assign to each variety its graded position, as good barn-yard manure contains 1-2 per cent nitrogen, flesh 3 1-2, fish 2 1-2, fresh blood 3, dried blood 12, skin 8, wool, hair and horns 16. On this standard we have the following value of barn-yard manure as compared with these animal substances: one hundred pounds of average animal excrement are equal to fourteen pounds flesh, twenty pounds fish, sixteen pounds fresh blood, twelve pounds skin, and six pounds wool, hair and horn. Whoever, therefore, buries and wastes a dead horse weighing 1,000 pounds, loses what is equivalent to four tons of barn-yard manure, and what by composting with muck, may be made equivalent to eight tons. This is not mere theory. We have composted hundreds of dead horses, using muck as the basis, and the compost applied to grass causes a luxuriant thick growth, which, when mowed with a scythe, rolls over like a fleece of wool.

We are more indebted to the decomposition of organized animal matter for the fertility of our soils than is generally supposed. Not every vegetable that grows passes into the higher animal organization, but the great end of vegetable life apparently is, to purify the air and fit it for respiration, and to support in every way the animal economy. Providence furnishes the vegetable food in no stinted supply. Far more grows each year than animals consume. Nature, or rather the God of nature, never suffers creatures to want for food, if they will only put forth the effort necessary to help themselves. There is, however, no waste. What the infinite variety of animated existence does not consume is reproduced, and what passes into the animal economy is still more speedily restored to the vegetable state. Much goes into the air in the form of ammonia and carbonic acid, but every shower, every snow-storm, and every deposition of dew brings down the ammonia, and every leaf is drinking in the carbonic acid.

The skill of the mechanic in passing water through his engine in the form of steam, giving great motive power, and then condensing the steam and returning it to the boiler to go over the same journey, is small in comparison with the wisdom of the Creator, who is also the Great Agriculturist. The microscope reveals the fact that myriads of animalcules, too minute to be seen by the naked eye, are constantly converting vegetable matter into animal life, and we see myriads of ephemeral insects of a summer's evening floating in the air, born in the morning and dying in the night. These all have their mission to perform, and it is not merely to convert putrescent matter into life, which would otherwise fill the air with poison, but in their death they give life to the vegetables from which their own life was drawn. The earth is the great absorbent of all this fertilizing matter, and uses it for clothing herself with a verdant and beautiful vestment. Let us be co-workers with the Infinite One, and direct this decaying animal matter into the channels where it may best subserve its legitimate purpose.

This leads us to say that the application of manure is a not much less important subject of study for the farmer, than its manufacture. It is a mistake to suppose that all manure is alike, and to be applied indiscriminately to all lands, all crops, at all times, and in all stages of fermentation. As different animals, and the same animals in various stages of growth, require different kinds of food, just so it is with plants. What is food for one is rejected by another. No two species of plants have precisely the same chemical composition. Both the organic and inorganic constituents differ. The ashes of different woods vary so greatly that the soap boiler, whose sole object is to secure the potash, can afford to pay ten times as much for the ashes made from beech as for those made from some of the fir trees.

The analysis of soils and plants has not yet done for agricultural chemistry all that was hoped. Perhaps too much was expected. We can not analyze a soil and tell precisely what ingredients are wanting, and precisely the amount, to make it productive of this or that crop. The mysteries of nature's laboratory are too intricate to be perfectly developed in one year, or one century. Approximations only have thus far been attained, and some errors have doubtless been made. Practical agriculturists, however, owe much to the labors of such men as Liebig in Germany, Johnston in England, and Johnson in America. Enough has been done to encourage still further investigations on the part of the chemists, and closer observation on the part of farmers. We know that potatoes require an extra allowance of potash, that turnips feed largely on the phosphates, clover on the sulphates, and that cabbages, grasses and grains demand a liberal allowance of nitrogenous manures.

Not only must the adaptation of the manure to the crop be studied, but its mechanical effect on the soil must also be considered. In a close, retentive clay, one great object in manuring is to make the soil more open and friable; and for this purpose green manure, abounding with organic matter, is plowed in. But when the soil is already light and open, coarse manure may make it more so, and may materially injure the mechanical condition, and be attended with great loss of the most valuable constituents of the manure. In such a case it is better that the manure be fermented in the compost heap, in connection with more vegetable matter.

Clay is so good an absorbent, that in a clay loam there is little loss from evaporation; but in a sandy loam manure wastes rapidly, and should be applied only in connection with some absorbent, and as short a time as possible before the sowing of the crop.

When fresh manure is plowed in upon a clay soil, a little well rotted compost should be scattered over the surface to give the crop a good start. Neither plants nor animals should be stunted at any season of their growth. On a clay loam of medium fertility the young shoots of corn would find poor living, if the manure is all buried six or eight inches below the surface. With a light top-dressing, harrowed in after the land is plowed, the plants have a good start, and when the roots reach the long manure they are invigorated in the latter part of the summer, for a good home stretch, as the jockeys call it. We formerly plowed in most of our manure in a green state, but on re-plowing the land (a clay loam), the next fall or spring, we would often find the manure only slightly decomposed. It had been canned up too closely for the air to act upon it, and our practice of late years has been to compost all our manure and use it near the surface. This is the mode which the Great Proprietor of the earth adopts, who scatters the leaves and all other enriching matter near the surface. Mineral manures, all agree, should never be applied anywhere else. In their case there is no danger from evaporation, and their tendency is constantly to sink into the soil. If nitrogenous manures are well composted, little fear need be apprehended of evaportion, and even fresh manure, if exposed on the surface, loses less than is commonly supposed, for in a dry day the surface is coated with a filament which prevents the escape of the gases, and in a wet time the water absorbs them and washes them into the soil.

We will add only one more suggestion respecting the application of manures, and this is the law, "that like produces like." It has been found that no manure is so good for grape-vines as the trimmings of the vines themselves, and for the good reason that these trimmings contain just the elements that the growing vines need. It is in this way that our native forests are enriched. The leaves and lower branches are constantly falling off, (a spontaneous pruning of nature's,) and by this means the trees receive such nourishment as is best adapted to their growth. The principle is doubtless one of universal application. The manure made from any crop can be returned to that crop with great certainty of accomplishing good. Thus, if our pork is corn-fed, the manure from our hog-pens should be returned to the corn-field. As hay is the chief food for cows, so the cow-stable manure is an excellent top-dressing for the meadows. A little aftermath left on the mowing lots and pastures will do them no damage. It will not only elaborate the juices of the grass for the benefit of the roots, and protect them from the severity of winter, but in its decay will be incorporated with the crop of the succeeding season. The subject of manures is an extensive one, and we are conscious of not having done it justice. We desire in closing to reiterate the principle we have endeavored to unfold: *The farmer must add to the soil sufficient supplies of everything he carries off in his crops.* Special manures may answer for one crop and one season. Phosphate of lime may raise good corn or turnips, but the succeeding crops will demand a manure containing a greater variety of food. Barn-yard manure contains this variety, and this must be the main resource of the farmer. When the fever for guano was at its hight, a few years since, a friend remarked to us, "I would not cart barn-yard manure a mile, if it were given to me, so long as I can get guano." We have lived to see him discard guano, and return to the barn-yard, which must ever be the main-stay of the farm and farmer.

LECTURE SEVENTH.

CHAPTER XXIV.

THE HAY CROP.

GRASS is king among the crops of the earth. More land is devoted to its cultivation, and more money realized from it than from any other product, cotton not excepted. Our southern brethren a few years since crowned cotton as king, but events showed him to be a usurper of a throne which rightfully belongs to grass. Mankind for ages lived without cotton, but never existed without grass. Paradise would not have been paradise, had not its fields been covered with a carpet of green grass; certainly, the animals that came to Adam for their names, would have found miserable forage, and man a short career, had not the verdant herbage of the pastures furnished them sustenance.

The statistics of the nations of the earth, prove that grass is the most essential, and most remunerative of all crops. This is true, taking the world at large, and is particularly true in New England, as by the character of our climate we are compelled to stall-feed our cattle nearly half the year. By the official returns of the products of Massachusetts, for 1865, we learn that the value of the hay crop for that year was $13,195,274, while corn, including broom corn, was less than three millions, potatoes about two and a half millions, oats a little over half a million, and rye about a third of a million. If we add to the hay the value of the grass consumed in the pastures, it will be found that the grass grown in Massachusetts exceeds in value all the other agricultural products combined.

We thus see that grass is one of the most important subjects that can occupy the attention of farmers. The annual value of the grass crop in our whole country, including pasturage and hay, can not be less than $500,000,000. According to our last state census, we have in Massachusetts 90,282 horses, about 50,000 oxen and steers, and 174,386 cows and heifers, and all these animals, which minister to our necessities and comforts, are mainly sustained by the grasses. So thoroughly convinced are our most sagacious farmers, of the importance of this crop, that with most, it occupies the chief position in the rotation, and indeed all other crops are cultivated with reference to an increase of this leading staple.

Grass is an indigenous product of our soil. Other useful crops must be sown, but grass springs up spontaneously. As soon as the forests are cleared and the sunlight is let in upon the ground, grass makes its appearance, clothing nature with a verdure most pleasing to the eye, and at the same time furnishing the most nutritious forage for the cattle that roam over our thousand hills. A struggle does indeed immediately commence between the useful grasses, and the worthless thorns and brambles, much like the struggle between good and evil in the moral world; but it is encouraging to know that the good, useful and beautiful are sure to triumph, when cultivation lends its helping hand.

As a father by proper vigilance and culture can train up his family in the ways of righteousness, so the farmer, by constant cultivation, can be sure that the grasses will root out all noxious weeds. Every careful observer must have noticed that where cattle leave their droppings in the fields, thorns do not spring up, but in lieu thereof, a rich mat of grass.

As it is easy and natural for man to speak the truth, so it is natural for the fields to produce grass. The thistles and weeds come only by neglect. If any one wishes to know how to eradicate daisies and johnswort from his meadows, we say to him emphatically, top-dress them richly with good compost, and if the grasses do not get the start and choke out the vile interlopers, then our experience and observation has not been extensive enough to form a general principle. We have seen fields, and must confess to having owned them, so white with daisies, that a passenger on the cars supposed they were luxuriant with an early crop of buckwheat; and these same meadows, by the simple process of top-dressing, have exchanged their pale-faced look for one of deepest green. Whether nature spontaneously produces good or evil, grass or weeds, we may leave for the metaphysicians and theorists to speculate upon, but this much we know practically, that if land is well cultivated, where weeds abounded grass does much more abound.

It is not a little singular to notice in this connection, that the sowing of grass seed is a very modern practice, and America has the honor of discovering that the natural grasses may be improved, and the crop of hay greatly increased, by carefully collecting and sowing the seeds. When our fathers left England in 1620, red clover was unknown there, as a distinct crop, and it was more than a century after this, that the English began sowing the chaff and seed collected from their barn floors and around their hay-stacks.

In 1769 the London society for the encouragement of arts offered premiums for the collection of seeds of the wild grasses, and experiments in the culture and comparative value of the natural herbage of the island. The mildness of the English climate allowed the farmers of that country to rely upon the native products of the soil for the sustenance of their stock, but the rigors of our New England winters soon compelled our fathers to resort to more artificial resources for forage. Indeed, we read in the early history of Plymouth and Massachusetts colonies, of whole herds of cattle dying from starvation and exposure, ere our fathers had learned the necessity of barns and the value of good hay.

The Puritans were very pure and noble, but if we should treat our cattle as stock was treated in the first century of our colonial history, Mr. Bergh would expose us in the *New York Tribune*, and bring us to justice for cruelty to animals. We trust that the Puritans did it in ignorance. Clover was introduced into England about 1633, but the cultivation of timothy and orchard grass the English learned from us, more than a century afterward, and it was not till the Duke of Bedford made his experiments, early in the present century, that the grass crop assumed the importance it now commands; and we do not think it has yet generally attained the relative position and attention it deserves among the products of the earth. It is like the air we breathe, so common and so cheap, that we undervalue it. We avoid treading upon the blades of corn, but walk upon the velvety turf without compunction, but the grass "crushed to the earth rises again," and is found, like truth, to prevail over all its foes.

Chemical analysis and careful experiment agree in assigning a higher nutritive value to well-made hay, in comparison with grain and roots, than is commonly supposed. The general impression is that grass-fed beef must necessarily be poor, and that cattle fed on hay alone during the winter improve but little in size and deteriorate in flesh. That grass-fed beef is often poor, and that our herds make little growth during the winter and are generally "spring-poor" in April, we can not deny. But the lean, blue beef must not be charged to the account of the grass, nor the skin-and-bone appearance of the stock to the account of the hay. Let the cattle graze in pastures luxuriant with white clover, redtop, June and orchard grass, and the beef will be fit to set before an English king or a New York alderman.

The trouble with grass-fed beef is that the pastures are either starved or overstocked, and if the lean kine that go bellowing about in the spring, or stand shivering and shriveled under the lee of some fence, could speak English, they would say with Oliver Twist, "We want some more."

We have seen cattle luxuriating in rich pastures, whose flanks and sirloins fairly rolled with fat; and we have no doubt that beef thus made is more healthy than where the animal is confined in a dark stall, condemned to breathe impure air, fed with oil-cake, and deprived of all exercise. We have also seen herds of cattle wintered on hay, that continued growing during the winter, and looked as sleek and thrifty in the spring as when housed in the fall.

There is no necessity, therefore, for poor grass-fed beef, nor poor hay-fed stock. If any reliance can be placed on Boussingault's table of nutritive equivalents, 100 pounds of good English hay are equal in feeding qualities to 65 pounds of barley, 60 pounds of oats, 58 pounds of rye, 55 pounds of wheat, 70 pounds of corn, 382 pounds of carrots, 319 pounds of potatoes and 676 pounds of Swedish turnips. Other chemists make these equivalents a little different, but all make the relative value of hay higher than most Yankees would guess or most farmers would calculate, without making accurate experiments.

We must, however, remember that the hay with which these grasses and roots are compared is good English hay, not the rough scurf of our meadows composed of daisies, thistles, and other weeds, with a few spires of grass thrown in for seasoning, and the whole allowed to stand on the sod till most of the nutriment has gone to the formation of seed, that has been scattered by the birds and insects to the four corners of the earth. It is because much of the hay which we feed to our stock is of so poor a quality, that we estimate its nutritive value at so low a rate. Practical farmers, who have carefully experimented in feeding good hay, grain, and roots, do not differ materially in their conclusions from the analyses of scientific chemists.

Thaer, from his experiments, estimates 100 pounds of hay as equivalent to 76 pounds of barley, 86 pounds of oats, 71 pounds of rye, 300 pounds of carrots, and 460 pounds of mangel-wurzels. The grains, it will be noticed, rank lower in the practical experiment than in the chemical analysis. From both experiment and analysis, we conclude that a hundred pounds of hay are equivalent in nutrition to one bushel of corn or barley, two bushels of oats, four bushels of potatoes and five bushels of carrots. As there can be no question but that we can raise a hundred pounds of hay at less expense than a bushel of corn or five bushels of carrots, it follows that hay should be the leading crop, where crops are raised to be fed out to stock.

We know that in comparing substances so unlike as hay and roots there is some uncertainty, especially in the analytical comparison. It is too much like comparing chalk and cheese. There may be some homeopathic dose of medicine in the carrot so minute as to escape the chemist's test. We would, therefore, by no means condemn the roots. We raise them and have faith in them. It is not because we like corn and roots less that we thus speak, but because we like hay more. We should be sorry to confine our cattle to dry hay alone for the six long months of our winter, but if we can not have both hay and roots, we speak for the hay. It is for the animal what bread is for man, the staff of his life.

How then can we increase the quantity and quality of our hay crop? We reply,—in the first place, by sowing a greater quantity and variety of seed. Our ancestors sowed no grass seed at all, relying for a crop of hay solely upon the spontaneous production of the soil. A step in advance of this was the practice of sowing the refuse seed, scattered on the barn floor and around the hay stack. Another step was sowing a small quantity of two or three varieties of clean, selected seed; and we have another long step to take, and sow liberally of half a dozen or even a dozen of the hundreds of the different grasses that we find growing naturally in our fields. "He that soweth sparingly shall reap also sparingly, and he that soweth bountifully shall reap also bountifully," is emphatically true in the hay crop.

We remember the time when the custom was to sow twelve quarts of grass seed to the acre, generally eight quarts of timothy and four of clover. This gives about 14,000,000 seeds, or 300 to the square foot, and this would be a sufficiency if we could be assured of an equal distribution and certain germination, but this is impossible. Besides the difficulty of an even distribution, many of the seeds are spurious, some are devoured by birds and insects, and more still are lost by having too much or too little depth of earth, generally the former. Most of our grass seeds germinate most surely when only covered one-fourth of an inch, and by actual experiment it has been ascertained that when covered an inch, half the seeds fail.

We can learn something of the necessity of abundant seed-sowing by observing how bountifully nature provides seed, so as to guard against all contingencies and to insure the reproduction of the plant, which seems to be the great aim of all vegetation. A bushel of timothy will average over 50,000,000 seeds. An acre of corn will produce seed enough to re-stock 200 acres. Let us imitate nature and sow more bountifully, that we may also reap more bountifully. It may be possible to overstock land with grass seed, but we have never known such an instance, and we are confident that a hundred fields are damaged for the want of seed where one suffers by being overstocked.

There has been great improvement in the amount of seed sown within the past few years, and some of our best farmers now sow a bushel of redtop, half a bushel of timothy and one-eighth of a bushel of clover. This is progress in the right direction, but is this a sufficient variety of seed?

The addition of redtop is a great improvement.

Though it does not show itself much the first year among its more precocious and aspiring neighbors, timothy and clover, still it fills the lower and vacant places, and as the clover dies out, raises its modest and beautiful crest and furnishes a hay of the first quality, especially for neat stock, and it has the great advantage over timothy, of not suffering so much from not being cut just as it comes to maturity. The long stem of timothy, as soon as it has served its purpose of conveying nutriment for the production of seed, becomes dry, hard, woody fibre, about as indigestible as an old chestnut rail; but redtop thickens up from the bottom, and remains succulent for a long time.

There are, however, many other grasses worthy of cultivation besides timothy and redtop. And here also we should learn a lesson from the variety which naturally grows in our rich and permanent meadows and pastures. An examination of an old, rich pasture will disclose ten or a dozen, and sometimes even twenty distinct species of grass growing side by side. These different varieties draw on the soil for different elements of nutrition, so that the exhaustion of any one element is not so great as might be supposed. Mother earth is much like a mother hen, that scratches no harder for a dozen chickens than she does for one. We should consider it miserable economy to bring up one, two, or three chickens under one hen, and it is almost as bad economy to sow only two or three kinds of grass seed. In most of our newly stocked ground many vacant spaces occur, and though they may seem small, still in the aggregate they amount to a large quantity, and very sensibly diminish the harvest. The grass which does grow may have a more rank growth from luxuriating in so much space, but does not furnish so tender and delicate hay as when it grows more compactly.

We have seen fields of timothy that, at a little distance, looked as though they might yield a great crop of hay; but when we examined them more closely, we found the stems too far apart. Nature abhors a vacuum, and if the meadow is rich and remains for a series of years in grass, fills up these vacant spaces with other varieties; but would it not be better for us to take time by the forelock, and sow a greater variety of seed, and not waste years in waiting for nature to make up for our deficiency? In her abhorrence of vacuums she may put in such kinds of grass or weeds as we do not like, and it is always better to forestall and guide her in the operation. Where she gets her seeds to fill up the vacant spaces is a mystery. Some of them may have lain dormant in the earth, only waiting for favorable circumstances under which to germinate; others may be brought by the winds and the fowls of the air, or be disseminated in the top-dressing.

We were surprised a few years since by seeing our fields covered with the meadow-fescue, of which we had never sown a seed, and did not even know the grass. It still lingers in our meadows, but whence it came is as much a mystery as the change of the wind. We found it an excellent early grass, and should not object to it as a standard variety to be sown regularly.

Where land is stocked down for grazing, a variety of grasses which will ripen in succession is desirable, and we have varieties that are maturing in succession for six months of the year. In April the spear-grass blossoms; in May, the meadow fox-tail, the sweet-scented vernal and white clover. The number of grasses that blossom in June is legion. This is the carnival, or rather the graminivorous season for grazing stock, more grasses coming to perfection during this month than at any other season. We can only mention the most important: timothy, the various fescues, orchard grass, June grass, rye grass and red clover, which we class among the grasses, though strictly it is a leguminous plant. In July, come redtop, fowl-meadow and English bent. In August we have floating fox-tail, blue grass and creeping meadow; and in September, the hairy panic, reed grass and poverty grass, with many of the above mentioned, which continue in blossom from month to month.

It is worthy of observation that almost every grass will continue growing, if mowed or cropped before it goes to seed. As the production of seed is the great end aimed at in nature, no plant seems contented till it has accomplished this end, but lives and struggles against all obstacles till it has fulfilled this mission. When it has accomplished the purpose of its existence in producing seed after its kind, it is ready to die; therefore our pastures should be so closely grazed that none of the grasses will run to seed, and they will remain green and luxuriant throughout the season.

In stocking lands designed for mowing fields, it is desirable, though not essential, to sow those grasses which will mature about the same time. June, or Kentucky blue grass, as it is termed at the South and West, meadow fescue, red clover and orchard grass require early cutting in order to secure them in their best estate for forage. Timothy, the standard grass of New England, comes a little later, and redtop, next to timothy the great favorite, later still.

We desire to speak a word in favor of the much neglected orchard grass, which we have found one of the most luxuriant and nutritious, both for grazing and for hay. It never says die. It is the first to furnish a bite for the cattle in spring, is little effected by the droughts of July and August, and continues growing till the severe cold of November locks up the sources of its nourishment. When cut or grazed it starts up with the vigor of the fabled hydra.

During the past summer we mowed a luxuriant crop of this grass in June and another was ready for the machine by the first of August. In a few days it was fit for grazing, and as we did not wish to mow it a third time we let in the cattle from an adjacent pasture to graze upon it, leaving the passage between the two fields open. The feed in the pasture was good, but the cattle were seldom seen to return to it, evidently preferring the luxuriant and succulent orchard grass.

We advise no man to sow it on his lawn, for it would need cutting every morning before breakfast. We have grown it in one field for eight years, and see no diminution of the yield, though cutting two crops regularly each year. If cut while in blossom, both cattle and horses are exceedingly fond of the hay, and do well upon it. If left to stand till the seed are matured, it becomes more tough and wiry than even timothy, and cattle will need to have their teeth sharpened to eat it in this stage of its growth.

Our good opinion of this grass is strengthened by that of the late Judge Buel, one of the most discerning of agricultural observers, who says: "The American cocksfoot, or orchard grass, is one of the most abiding grasses we have. It is probably better adapted than any other grass to sow with clover and other seeds for permanent pasture or for hay, as it is fit to cut with clover, and grows remarkably quick when cropped by cattle. Its good properties consist in its early and rapid growth and in its endurance of drouth. Sheep will pass over every other grass to feed upon it. I prefer it to almost every other grass."

Mr. Sanders of Kentucky says: "My observation and experience have induced me to rely mainly on orchard grass and red clover. Indeed, I sow no other sort of grass seed. These grasses mixed make the best hay of all the grasses for this climate. It is nutritious and well adapted as food for stock. Orchard grass is ready for grazing in the spring ten or twelve days sooner than any other. When grazed down and the stock are turned off, it will be ready for regrazing in less than half the time required for Kentucky blue grass. In summer it will grow more in a day than blue grass will in a week."

This is the testimony of a man from the grass-growing State of Kentucky, where we have generally supposed that blue grass was the king of grasses. We might cite the testimony of Judge Peters, of Pennsylvania, and other eminent agriculturists, in favor of orchard grass, but we have said enough to call the attention of farmers to it, and if its general cultivation can be introduced into Massachusetts, we shall feel that we have done the State some service.

We will add that we do not favor sowing orchard grass alone. It is inclined to grow in tussocks, and thus leave much vacant space in the soil. This may be remedied, in a measure, by thorough pulverization of the soil, and by liberal allowance of seed, at least, two bushels to the acre; still we should prefer to sow clover, meadow fescue, timothy and redtop with it; so that the surface of the ground may be filled with roots, and all the virtues of the soil be brought into requisition.

We have found, too, that orchard grass loves a deep, rich, moist soil, and are confident that in such a soil no other grass yields such an abundant harvest. Why it is so much neglected among us we can not divine, unless it is the fashion of sowing timothy and clover, and fashion is as much a tyrant among farmers as among the ladies, though showing his power in a different mode.

CHAPTER XXV.

CUTTING, CURING, AND STORING HAY.

AS a second suggestion for the improvement of our hay crop, we mention early cutting. As to the time of cutting grass, farmers disagree. Some recommend cutting when the grass is in bloom, others when the blossoms have just fallen, others when the seed is in its milky state, and others still when the seeds are ripe. The advocates of the last-mentioned time are few, and growing beautifully less. As attention has been paid to the time of cutting grass and the observation of farmers has been turned in this direction, a great change has occurred in the opinion and practice on this point, and the grass of Massachusetts is probably cut a fortnight earlier now than it was ten years since. Towards this result the mowing machine has greatly contributed, as it enables us to finish the hay harvest with great dispatch. Still the practice of many farmers is to be dilatory in their haying, and the consequence is that they lose much of the virtue of their hay. In 1856, the able and efficient secretary of the Massachusetts board of agriculture addressed a series of inquiries on the hay crop to one or more farmers in each town in the state, and this question was asked among others: "At what stage of growth do you prefer to cut grass to make into hay?"

Answers were received from more than two hundred towns, and those from a hundred and fifty towns, about three-fourths of the whole, a majority sufficient to overcome any veto, were in favor of cutting timothy and red-top when in full bloom, and red clover when about half the heads are in blossom. This we think is the true theory, but we fear the practice, though greatly improved of late years, is not up to the theory.

Grass passes so rapidly from the blossoming stage to that of mature seed, that before we are aware, the virtues of the plant are concentrated in the seed, and the stalks and leaves become dry, hard and indigestible woody fibre.

Some argue that cattle love this dry fodder, and that there is more nourishment in it than in its green, succulent state. If so, why do not the instincts of cattle lead them to eat it when roving in the pastures and acting their option as to what they will eat?

All must have observed that when in any locality in a pasture the grass has gone to seed, cattle avoid it; and nothing but starvation will induce them to eat such grass. The instincts of cattle are a pretty sure guide, certainly as likely to be correct as the abstract reasonings of the minority of men.

The true principle in haying, is to secure the hay at a time when we can harvest the largest amount that shall be like grass in its perfect state, and this we can do when the grass has attained its growth, and before the starch, sugar and gluten of the plant have gone to the formation of seed, or been converted into woody fibre. The starch and other nutritious compounds are on the increase so long as the plant grows; but with blossoming, growth ceases, and now is the time with the least labor to secure the greatest amount of forage in its best condition.

Our mothers, when they sent us out to gather pennyroyal and boneset, with the extract of which they expected to make good herb tea, always instructed us to select the herbs in full bloom. They may not have understood the chemistry of plants, but they knew from trial that these herbs while in blossom made the strongest decoctions, and that this was the time to dry them for future use. Miserable herb-drink would boneset make, if left in the field till the stalks and leaves were dry and the substance of the plant transformed into seed. Now dried grass is not unlike dry herbs, and a good test of the quality of hay is found in making a decoction from it; and whoever tries it will find that hay cut while the grass was in blossom makes the strongest extract.

Just so the hop-grower is always careful to pick his hops, not in the old of the moon in August as the rule of superstition has it, but when the hops are in full bloom, and the pollen of the flowers most abundant, for picked at this time they make the strongest ale. We do not desire to make ale from our hay, but we do desire to preserve all the aroma of the flowers and all the stimulus that green hay gives to the animal system.

We have heard it said that timothy cut when in blossom is apt to be dusty. We doubt very much the truth of this. The idea probably originates from the pollen of the blossoms being scattered at the time of harvest, giving the appearance of dust, but from such dust we should apprehend no evil to cattle or horses.

A third suggestion for the improvement of our hay crop is the mode of curing and storing it. We have already suggested that hay is analogous to dry herbs, and that hay is best from which the strongest decoction can be made. Here, too, we can learn a lesson from the manner in which our mothers cured and preserved their herbs. If we remember rightly, it was not to put the herbs in the open air, exposed to sun and winds till they were crisp and brown as the leaves of autumn; but they were carefully dried in the garret, and when sufficiently dry, but still retaining the green look and plastic condition of life, were wrapped in papers and stowed in the medicine chest.

We fully believe there is such a thing as drying hay excessively, exposing it to the sun and winds till much of its virtue has escaped into thin air. Every farmer must have noticed the stimulating effect of the aroma of drying hay, which enables him to perform more labor in haying, and with less fatigue, than in any other occupation. He feels, as he sticks his pitchfork into a cock of hay, that it must come. A man with ordinary muscle feels that he has the strength of Ajax. Raking among the heavy windrows seems to him but play. This stimulating effect we ascribe to a principle in hay similar to the theine in tea; and to preserve this principle for the benefit of the horses and cattle, should be our aim in curing hay.

In order to do this, hay should be exposed but little to the sun and winds, and dried as far as possible in the cock. Of course no good farmer will expose his hay to the dews and rains. The starch, sugar and gum of grass, which are the fat-producing qualities, are all soluble in water, and are wasted by contact with it. The hay cap is a great improvement, as it not only keeps out the water, but keeps in the theine. This stimulating principle, which, for the want of a better name, we call theine, if it does not contribute directly to building up the animal system, at least acts negatively in preventing the waste of the tissues, acting upon the animal very much as green tea does upon man.

The tired washer-woman is refreshed by her cup of tea at noon, and goes to her work after dinner with renewed energy. Beef and bread do not give her so much strength as does her coveted beverage. A toil-worn soldier once said to us, as he was sipping his cup of tea of a cold winter's morning, "Good green tea sets me up for all day," and we have no doubt good green hay "sets up" the horse for his all-day labor. With many persons hay is hay, no matter whether green or brown, bright or moldy; but there is as much difference in hay as in tea.

The Chinese tell us that the young, fresh leaves are the most tender and delicate, furnish the most soluble matter and give the highest flavor, and that the difference between green and black teas does not originate with the shrub, but in the different mode of curing. In making green tea the leaves are roasted immediately after they are gathered, and the whole operation of rolling and drying is speedy; but in making black tea the leaves are spread in the air for some time after being gathered, and when rolled are exposed again to the air for a few hours in a soft and moist state. It is, therefore, by a lengthened exposure to the air, accompanied by a slight fermentation, that the dark color is given to the black teas. Whoever prefers black hay to green can easily tinge his grass with the dark hue by exposing it to the air long enough; and we believe that more hay is damaged by this exposure, than by being mowed away in too green a condition.

We desire to say one word here for the aftermath, or rowen crop. This is often spoken of as of little value. We have heard it compared to the foam of syllabub, having no substance in it. It might as well be said that grass has no substance in it. Rowen is simply the green grass preserved for winter use; and for sheep, calves and milch cows we know no forage equal to it. For horses and oxen, upon whose muscular system the great tax is laid, we should prefer hay made from more mature grass, that furnishes more fibrin. As in summer we turn our cows out to grass and keep the oxen stall-fed on old hay, so in winter we should feed the milk-giving cows with rowen, and the oxen and horses with more mature hay.

By cutting our grass early, before the plant had become exhausted in production of seed, we have been enabled for many years to cut a second crop, and though the market price of this is always less than for the first crop, yet for feeding to certain kinds of stock we have found it preferable. One great trouble with rowen has been that it came so late in the season as to render the harvesting of it difficult, and much of it has been secured in bad condition; but with an early hay harvest, the aftermath comes earlier, and by curing it mostly in the cock there is little extra labor, and it will prove a very remunerative addition to our stock of forage.

The storage of hay is another topic to which we will briefly call your attention. Shall we put our hay into large, tight mows, or into open barns and on loose scaffolds? If curing and keeping hay is analogous to curing and keeping tea, then the larger and tighter the bays the better will be the hay. We have seen a large and famous barn with a shaft coming down in the center of the mow for the purpose of ventilating the hay. We should as soon think of ventilating a tea-chest. We have seen other barns with wide gaping cracks on the sides of the mows, apparently left for the purpose of admitting air to the hay, and we were advised, not long since, to put none but thoroughly-dried hay at the bottom of the mow, as the air could not reach this part to cure it more effectually.

These facts show that the true principle in keeping hay is not universally understood. Air may be essential in the curing of hay, but not in its storage. After it is ready for the barn, we would not object to having the hay sealed up hermetically. Even green grass thus sealed can not ferment or decay, any more than does a peach when canned. Decay is only a slow process of combustion, and combustion can not take place without air. If we examine our mows after we have put upon them some imperfectly cured hay, we shall find that it is only the top, where the air can circulate, that ferments and heats.

In the olden times of New England it was customary for the country clergyman to eke out his meager salary by cultivating a small farm, and in the haying season, the farmers made what was called a bee, and on an appointed day came together and cut the minister's grass and stored it in his barn, generally finishing the whole job in one day.

It was a joyous occasion, and the farmers were early at their work, and we well remember being waked up in the morning by the merry voices of the mowers, and the musical clang of the scythes as they were whetted in concert.

Almost necessarily much of the hay was housed before it was thoroughly dry, but being stored in one day, there was little opportunity for the air to act upon it. We have fed out much hay thus imperfectly cured and rapidly stored, and though the top of the mow was sometimes moldy, the bulk of the hay came out in good condition. We very much question whether green hay placed on a scaffold would keep as well. Imperfectly cured hay stored in a mow at intervals of a few days, will be very likely to furnish layers of musty fodder, for the surface-section of each batch will thus be exposed to the air and will ferment and mold.

In feeding hay, it is found economical to cut down the mow in sections and not to feed from the entire surface, as the exposure to the air in this case is much less. It is often remarked that hay fed directly from the mow spends much better than when it is moved from one barn to another, and we have no doubt it is so, as the hay can not be moved without losing a portion of its aroma. More reprehensible still is the practice of pitching on the barn floor overnight what may be required to be fed out in the morning. We should as soon think of taking out of the tea-chest at one meal the allowance to be steeped at the next.

CHAPTER XXVI.

THE MOWING LOT.

AS a final suggestion for the improvement of our hay crop, we would mention a little more attention to the mowing lots. We draw on these lots year after year, and often make no deposits by which to enable them to honor our drafts. This is too much after the manner of the horse-leech, which cries, "Give, give." There is a homely proverb which says, "We can't get something for nothing," but many farmers act as though they could get grass for nothing. It is wonderfully cheap, and grows in spite of neglect, but there is a limit to the capacity of our meadows and pastures to produce even grass.

Already the average production of the meadows of Massachusetts is less than one ton per acre, and some three or four acres of pasture are required to support a cow, whereas the average of hay should be two tons per acre, and a cow should not be compelled to traverse more than 160 square rods of grazing for her support. How shall we bring the grass lands of Massachusetts up to this standard? We answer, by the two simple means of tile and manure. We formerly thought that manure was the foundation of good farming, but our late experience is that draining is the first thing. They certainly work well together, and neither is fully efficient without the other, but draining comes first in order of time. More of our land needs draining than is commonly supposed. Wherever water stands after a shower, or the coarse herbage shows that the roots have a watery bed, there the tile are necessary, before remunerative crops can be obtained.

An energetic manufacturer, who has lately turned his energies to farming, recently said to us, "Tile works like magic on my land. Where my horses could hardly walk even in a dry time, I now can plow immediately after a rain." Such is the experience of all who have tried thorough drainage. Not only can the land be worked immediately after a rain, but a fortnight or a month earlier in the spring, and the lengthening of the season in the autumn is nearly as great as in the spring. Paradoxical as it may seem, the drained lands suffer much less in a drouth than the undrained, the roots of the grasses having more "depth of earth," and the moisture being drawn up in due proportion by the capillary attraction of the granules of the soil, acting like small tubes, as does sugar or a lamp wick. There are thousands of acres of mowing lands in Massachusetts where the herbage is scanty and of poor quality, not because the soil is poor, but because the roots are water-soaked. Water is good; neither man, beast nor plant can live without it, but neither animal nor plant designed to live on terra firma can flourish if compelled to make a home in water. Drainage alone will so change the character of these lands that more nutritious grasses will spontaneously spring up where the coarse aquatic plants once grew. Wherever water stands, the land must be cold. The constant evaporation carries off all the heat furnished by the earth or by the sun.

Every tyro that is big enough to go bathing, knows that the evaporation from the surface of his body, as he comes out of the water, makes him shiver even in a warm summer day, and every one that has experienced this sensation should know enough not to let his land lie shivering in the wet. The quantity of heat that becomes latent by the expansion of water into vapor will surprise those that have not made accurate experiments upon it. Chemists tell us that steam contains a thousand degrees more of caloric than the water from which it is evaporated. If we can save all this caloric in the soil by draining off the surplus water, instead of leaving it to be evaporated, it will prove a great gain. When the land is thoroughly drained, there will be less danger from the late frosts in spring and the early frosts of autumn. We have noticed a part of a field of buckwheat that had been drained, in full bloom after a September frost, while another part, undrained, was damaged. Grass stands the cold and wet better than any other crop, but if we wish green fields early in the spring and late in the fall, they must be drained, and thus be rendered dry and warm. We are more and more convinced that a warm soil, other things being equal, gives great advantage, and in no way can this warmth be so effectually promoted as by the use of tile.

By draining our meadows we also double and sometimes quadruple the depth of the soil. The theory is that the land-owner owns from the surface to the center of the earth, but practically it often happens that he owns only a few inches of the surface, for water has possession of the balance. In much of our undrained land the roots of the grasses extend down but a short distance. Meeting the cold water, they are chilled and repelled. The roots of the trees, even, do not venture into the cold, inhospitable, watery subsoil. We have often noticed trees struggling to live in wet, undrained land. They send out their roots foraging for food, but the roots never penetrate to any great depth. They are confined to the surface, and furnish precarious sustenance and precarious foot-hold for the trees, which are stunted in growth, and are often overturned by the wind, the roots taking up with them the thin stratum of soil, and exposing a subsoil almost destitute of vegetable fiber.

The propensity of land-owners is to add land to land, to extend the superficial area of the farm, to covet, as Scott says, "All that lies contiguous to us." Will it not be just as laudable an ambition to extend our possessions perpendicularly as laterally? Is there not as much satisfaction in harvesting two tons of hay from one acre as the same amount from two acres? This creating good land from poor, making ten blades of grass to grow where one grew before, furnishes a satisfaction analogous to the pleasure of the Creator, who looked upon the works of his hands and pronounced them good. Adding acre to acre is merely a commercial transaction, and shows depth of purse rather than of mind. We have no objection to large farms, if the capacity of the landlord is equal to the extent of his domain; but to skim over a great surface for a little produce is neither pleasurable nor profitable. Our meadows have been specially exposed to this skimming process. In the case of our hoed crops, we know it will not pay to plow and waste our seed and the sweat of our brow upon cold, wet land; but our meadows we have been inclined to treat as though grass could grow anywhere. Grass is very accommodating, and does try to grow in the most uncongenial soil, but a few tile underneath the surface give great aid and comfort even to grass.

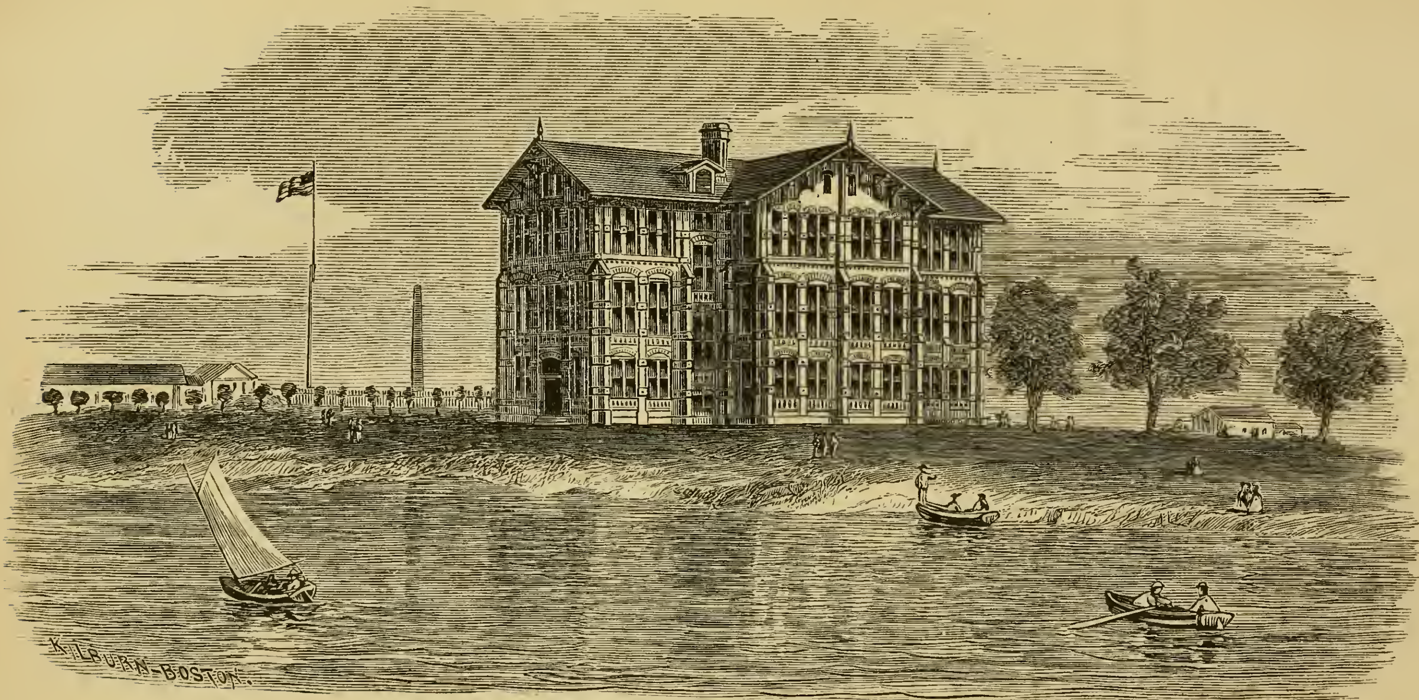
When land is drained the air penetrates the soil, decomposing dead vegetable and animal matter, and recomposing it into new life. This twofold action of air is wonderful. No sooner does an animal or vegetable die than the oxygen of the air seizes upon it to resolve it into its elements and reconstruct these elements into new forms of life and beauty. But this process can not go on when air is excluded by water. Witness our muck swamps, which are vast accumulations of vegetable matter, kept from decay because covered with water. When drained, the muck begins to decompose, the swamp settles, and the nutritious grasses make their appearance upon its surface. Not only does the air penetrate the drained land, but the rains, bringing with them the nutritious gases of the atmosphere, descend and percolate through the soil, leaving these gases for the nourishment of plants. This is the normal mode in which water should act upon our meadows. They like to *drink* water as man drinks it, but are just as much opposed to being drowned as man is.

Drainage, however fundamental it may be for the improvement of our grass crop, is not alone sufficient to accomplish all that is needed. Most of our meadows must be top-dressed if we desire them to accomplish all that their capacity allows. Draining is the forerunner of manuring, and prepares the way for the efficient action of the manure. Subtracting the water does, indeed, allow the vegetable and mineral matter already in the soil to be digested by the plant, but few New England lands have all the food that plants need, and the deficiency we must supplement from the compost heap.

We know no crop that feels the quickening influence of manure sooner than grass, nor any that yields a more grateful return. Manure, applied to a hoed crop, increases weeds as well as the crop, but, applied to grass land, we have ever found the grasses to get the ascendancy, and the grass improves in quantity and quality year after year. It is just as unreasonable to suppose that meadows can endure perpetual cropping without some return, as that plowed land can. The meadows may endure the exhausting process longer, as in plowing, the vegetable matter in the soil is more exposed to the action of the air, and consequently wastes more rapidly, but we can not take off two tons of hay from a meadow yearly, without diminishing the potash, soda, and other salts requisite in the growth of grass.

Our alluvial meadows, formed by the deposit of the rivers, and annually refreshed by their overflow, may not need a top-dressing. The rivers often supply all the top-dressing necessary, and would wash away a good share of what we might apply. These river meadows form our most natural and productive mowing fields, where red-top, one of our best grasses, luxuriates. All other grass lands need, and should receive, aid from the compost heap. We have found autumn the best time to apply this compost. It is a season of comparative leisure, the meadows are less cut up by the cartage than they are in the spring, the fields receive some protection by the compost from the rigors of the winter, and the grasses receive the stimulus and take an early start in the spring.

It is objected to autumn top-dressing by some, that the rains and winds will waste much of the fertilizing matter. If the compost is fine, as it should be, and the meadows are covered with a decent growth of aftermath, as they should be, there is little danger of waste. It takes a great rain to wash manure from a meadow where the spires of grass are thick and of some length. If cattle are allowed



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to graze the mowing-lots till they are bare as a bald head, then the objection of washing off the manure might have some force, but no good farmer that takes pride enough in his meadows to top-dress them, will allow them to be thus over-grazed. Compost can not repair the damage done by over-grazing. Grasses, like all other vegetation, demand an elaboration of sap in the leaves and a return of some of this elaborated sap to the roots, and a man that shaves too closely with his mowing-machine, or allows his cattle to graze too closely, will find in his penny saved a pound lost.

One of the most observing of farmers remarked to us, recently, that "the close grazing of meadows is the easily besetting sin of the farming community." Top-dressing may remedy in a measure the evil effects consequent upon too close cropping, but can not compensate for the want of that vitality in the roots which is derived from the normal breathing of the plant through its leaves. It is curious to notice how lawns that are frequently mowed manage to secure this breathing apparatus. The grasses send out numerous leaflets close to the surface of the ground, which escape the scythe of the mower, mow he ever so closely, and thus the plants are sufficiently vitalized by the action of the air to maintain a stunted growth.

This is not the time to discuss the ingredients of the compost heap which is adapted for a top-dressing of our meadows. We will only say that we have found a compost made of muck and leached ashes in the proportion of six or eight bushels of muck to one of ashes, an excellent fertilizer for grass. The wood ashes furnish the inorganic food in great variety, while the muck supplies the vegetable matter and renders the soil light and porous, ready to absorb the gases of the air and furnish them to the grasses as they may be demanded. In case the meadows are naturally cold and wet, abounding already in clay or peat, we should substitute for the basis of the compost heap, sand instead of muck. Sand alone, when scattered upon a peaty meadow, has a wonderful effect in warming the land and inducing the growth of sweet, nutritious herbage. Indeed, we have found that meadows, well drained, after they have been mucked for a series of years, are greatly benefited by a top-dressing of sand, or better still, by a coating of the alluvial soil which is to be found on the river bank.

This alluvium contains not only sand but the disintegrated granules of the various rocks and soils that the river has brought down from miles above. We have used this alluvium lately in the compost designed for top-dressing and have been much pleased with the result. Where it can not be obtained easily, the wash of the highway, or the leaf mold from the forest answers a good purpose. The latter is particularly rich in all the elements of vegetable nutrition, and our forests can well spare some of it for the benefit of the meadows.

On a clover ley, plaster operates most favorably. Spread broad-cast early in the spring at the rate of 100 pounds to the acre, it increases this leguminous crop greatly. This great result from so small a quantity can not be attributed solely to the increase of plant food furnished by the two main elements of plaster,—sulphur and lime,—although as clover contains both these elements, they doubtless contribute directly to its nourishment. But plaster is also a great absorbent, and its efficiency must in a measure be attributed to its power of retaining the ammonia of the air, and furnishing it to the clover and other plants as they may demand. Plaster alone can not be relied upon to keep our meadows in heart for a series of years. Those who have seen its magical effects for a year or two, and have supposed that they could sell their hay and still keep up their meadows by spreading a little plaster upon them, have found themselves mistaken, and have complained that their fields became plaster-sick. The sickness was simply starvation for the want of a greater variety of food. Plaster, from its own elements and by absorption from the air, can furnish only two of the many inorganic elements which enter into the composition of all our grasses. Clover is doubtless more benefited by its action than the other grasses, as the ash of clover shows over 30 per cent of lime. Plaster is found to act with great efficacy in connection with wood ashes, as they supply the inorganic elements in which plaster is deficient.

Farmers may differ about the action of plaster, but in the efficiency of barn-yard manure they are all agreed, and in the production of this, hay is the main reliance. Why should not more of this manure be applied to the reproduction of hay, and thus the law of action and reaction be carried out? The more hay, the more manure; and the more manure, the more hay.

LECTURE EIGHTH.

CHAPTER XXVII.

ABOUT POTATOES.

BY the returns of the industry of Massachusetts for 1865, we find that potatoes rank third in money value among the agricultural products of this state, grass and corn only taking precedence. The number of bushels returned as the product of that year was 3,826,540, valued at $2,607,202. This includes only the potatoes raised in field culture. The amount raised in market gardens we have no means of estimating. The number of bushels of potatoes was nearly twice as great as the number of bushels of corn, but the cash value of the potatoes was estimated a little less. Considering the increased attention paid to the culture of potatoes since 1865, and adding the large amount raised in market gardens, we are safe in saying that this crop is now the second agricultural product of this state, and is destined to assume still higher importance.

Our climate and soil are well adapted to the production of this esculent, and the consumption is steadily on the increase. The crop has this great advantage to recommend it to the attention of eastern farmers, that owing to its bulky nature and the consequent cost of transportation, it does not come in competition with the products of the fertile prairies. In raising corn and wheat we may not keep abreast with our western friends, but in raising potatoes we have the advantage. It has been feared by some that our home production might glut the market, but the fact that the price has risen as steadily as the production has increased, may well banish this fear. We well remember when the price of a bushel of potatoes ranged from a Yankee shilling to twenty-five cents, and when the price ran up to half a dollar, it was feared that potatoes would be considered a luxury only to be afforded by the rich. Many looked for a substitute, and tried turnips and rice, but nothing was found to fill the place of this valued esculent. Now that the price in Massachusetts averages at the farmer's door seventy-five cents, and in the retail markets of the city over a dollar a bushel, the consumption is far greater than when the price was one-fourth of this sum.

By the United States census of 1860 the amount raised in the whole country was 110,571,201 bushels, of which 99,000,000, or nearly nine-tenths of the whole, were grown in the free States. Estimating the price at fifty cents a bushel, the proceeds from potatoes alone would have been, in round numbers, $55,000,000, and then this crop ranked fourth among the edible vegetable productions of the country,—wheat, corn and oats being more valuable. At present prices and with the present production, the estimate for the whole country must be over $100,000,000.

The potato was formerly used extensively in fattening stock, but the enhanced price since the potato disease first made its appearance, some twenty-five years since, forbids such disposal at the present time. If a farmer should now feed one hundred to one hundred and fifty bushels of potatoes, for such was the allowance for fattening a yoke of oxen, he would find it difficult to get his money back. The small potatoes may, however, still be fed to cattle with advantage.

As an article of diet the potato compares better with bread than any other edible vegetable grown in temperate climates. Like bread, it is farinaceous, free from marked taste, and thus is adapted to all tastes, and is fitted to be cooked and eaten with almost every other variety of food. Some object to the potato because it is so tasteless, but the same objection would hold good against water. Turnips and onions certainly have more taste, but where one eats these vegetables, five eat potatoes. It has become an indispensable luxury to the rich, and an equally indispensable necessity to the poor. How our fathers lived without it seems to us a mystery. Ignorance of its virtues must certainly have been bliss to them. We should be sorry to go back to those good old times. Its introduction as an article of food some three hundred years since, was an era in human happiness and progress. Valuable as is the potato as an article of diet, its composition shows that it is intended as an accompaniment of meat and not as a substitute for it, and this is the mode of using it adopted by all nations. The analysis of it gives seventy-five per cent. water and twenty-five per cent. dry nutritive matter. These proportions, however, vary with the different stages of ripeness and the different varieties. The more mature the potato, the less is the quantity of water, and some of the richer varieties give as high as thirty-two per cent. of dry nutritive matter. The latter consists of starch sixty-two per cent., sugar and gum fifteen, protein compounds nine, fatty matter one, cellular fiber nine, mineral matter four. The dried potato is less nutritive, weight for weight, in the muscle-forming properties, than any of the grains except rice, which it much resembles in composition, having, however, one-half per cent. more gluten. It is remarkable that the Hindoo, who lives mainly on rice, and the Irishman, whose leading article of diet is the potato, have a physiological likeness, being distinguished by the size and prominence of their stomachs. This peculiarity is accounted for by the necessity of their eating a large bulk of food in order to be able to extract from it a sufficient amount of nourishment.

We can not account for the great and increasing popularity of the potato as an article of food among the civilized nations of the earth from its nutritive properties, though these are not small. This universal popularity which causes the potato to be found on the table of the humblest cottager and of the most aristocratic nobleman, must be attributed to its adaptedness to all tastes, all ages, all climates, and the various grades of health. A native of the highlands of a tropical climate, it grows everywhere, but loves best the cool climate of the hills, and is found nowhere in greater perfection than in New England, and, we are confident, is destined to become the second crop in value in the Eastern States.

The potato, greatly as we value it, was very slow in making its debut into good society, and its history is at once interesting and instructive. It was first brought to Europe in the middle of the sixteenth century, by the Spaniards, under the name of papas, but made very little favor on its first introduction, and was considered as fit only for cattle. This may not be so strange when we consider that the Spaniards esteemed lightly for table use all vegetables, garlic and onions excepted. Sir Walter Raleigh carried potatoes to England in the latter part of the sixteenth century, but he little thought he was carrying the greatest contribution in the vegetable line America ever made to the Old World, corn alone excepted. Some may perhaps except tobacco also, but we make no such exception. Sir Walter planted them on his estate, near Cork, and thus unwittingly laid the foundation of Ireland's salvation from famine. They were soon carried over to England, but it was near half a century before they were much known at London. They were first raised in botanic gardens as an exotic curiosity, and when first used on the table were roasted and steeped in sack and sugar, or baked with marrow and spices, and even preserved and candied by the confectioners.

In 1663 the Royal society took some measures to encourage the raising of potatoes, with the view of making them an article of general diet and preventing famine, but they met with little success. The reputation of the potato was certainly "a plant of slow growth." In books of gardening, published towards the close of the seventeenth century, a hundred years after the introduction of potatoes into England, they are spoken of slightingly. One author says: "They are much used in Ireland and America as bread, and may be propagated with advantage to poor people." Another says: "I do not hear that it hath yet been essayed whether they may not be propagated in great quantities as food for swine." Evelyn, writing in 1699, says: "Plant potatoes in your worst ground. Take them up in November for winter spending; there will enough remain for re-stocking the ground, though ever so exactly gathered." They seem to have been esteemed, at the close of the seventeenth century, very much as we esteem artichokes.

In the Complete Gardener, published in 1719 by the famous nurserymen, London & Wise, they were not deemed worthy of even a passing notice; and Bradley, another famous horticulturist, speaks of them as inferior to radishes. The ignorance and prejudice of our English fathers must have been great or they must have had a very inferior potato under cultivation.

Merit is, however, always sure of finding its way sooner or later. In the case of potatoes, it was certainly later, for it was not till the middle of the eighteenth century, 200 years after their introduction, that they were generally known and cultivated throughout England. The Irish were keener-witted, and enjoyed the comfort and profit of potatoes long before their neighbors across the channel appreciated them.

Scotland began to raise potatoes on a small scale in gardens about 1740, and about twenty years after the demand for them was so great that the Scotch farmers began to raise them in their fields.

In 1796 about 1700 acres of potatoes were planted in Essex county alone, for the supply of the London market. The English were, however, slow to learn the best modes of cultivation, and for a long time a few of the tubers were removed from the ground in autumn and the balance left for seed, as Evelyn had recommended, covered with litter to save them from the winter's frost.

In New England the potato has always been appreciated, and nowhere is it raised in so great perfection and cooked in a greater variety of modes and with greater skill. So generally is it relished that it appears on the table every day in the year, and no vegetable keeps so well from one season to another. Whenever meat is cooked potatoes are sure to be cooked with it, and a New Englander would find it a sorry thing to go back to the good old times of his Saxon ancestors, when they sat down to the table laded only with meats and black bread. We may talk about the "good old times," but if we were put back to them, we should find it all talk and no potato.

In the early days, or rather centuries, of potato cultivation, it was treated as a species having no varieties. For the introduction of varieties we are indebted to the market gardeners near Manchester, England. Encouraged by the demand, these gardeners vied with each other in securing the earliest and best varieties. They marked the plants that flowered early, saved them and sowed their seeds, and by again watching for the earliest of these they finally obtained varieties which were two months earlier than those they had been accustomed to cultivate. In the same manner, by selecting the seeds of the most farinaceous, the best flavored, best shaped, and most productive, the quality and quantity were as greatly improved as the early maturity.

In this country we have until recently paid too little attention to this matter of variety. Some thirty years since we reckoned as surely upon a crop of potatoes as we now do upon a crop of beans. The potato disease was unknown; and, no matter what variety we planted, we expected a return of thirty or forty, and sometimes sixty fold. True, there was a difference in quality, then as now; but as long as all varieties were healthy, and the tuber was mainly used in feeding stock, we considered the variety as of minor importance. Many farmers planted the varieties indiscriminately in the same field, and housed them in the same bin.

This was ever a slovenly practice, a mixing of tares and wheat, which we fear some continue to this day. There is as much choice in the varieties of the potato as there is in the breeds of cattle; and, if we wish to attain any excellence or profit as cultivators, we must exercise the skill and discrimination of the stock-breeders. Some are hardy, others delicate; some ripen early, others late; some are well-flavored, others unpalatable; some prolific, others unproductive; some well-formed, others ugly; some farinaceous, others soggy. Now, if we plant healthy and diseased potatoes together, it is much like placing a robust child to sleep with an aged and infirm person. It is possible the vigor of youth may counteract the tendency to disease, which contact with the decay of age induces, but the chances are against it. Disease of every kind propagates itself. "One rotten egg corrupts the whole clutch," as the Irish saying is; and we all know how one rotten apple spreads decay through the whole barrel. So, in a hill or bin one rotten potato is a prolific source of disease to all its companions; and if we plant healthy and delicate potatoes together, or house them together, we show either ignorance of the law of catalysis or gross carelessness.

Breeders have laid down the most prominent points of a good animal, by which they are governed in awarding premiums and selecting stock, with as much faith as a churchman has in the thirty-nine articles of his creed; and we propose to name a few characteristics of a good potato. In the first place it should be healthy. As a good constitution is the first requisite of a good animal, so vigor is the leading quality of a good potato. No other quality and no combination of qualities will compensate for the want of this. We have never seen a potato that, for table use, came up to the Carter; but still few venture to plant this variety, as its constitution is so impaired either by age or abuse, that it can not resist disease, except under the most favorable circumstances. Planted on a fresh sod of an old dry pasture, and in a dry summer, it may make a good return, and some are so fond of this favorite that they continue to plant it, knowing that they run more than an even chance of losing their labor. The same objection, though in an inferior degree, lies against the Mercer, and indeed against many of the otherwise excellent table potatoes. We remember once hearing a cautious old bachelor say, that, in selecting a wife he should consider health as the prime quality. We were inclined to smile at his placing the physical above the mental and moral in a wife, but, as a potato has no mental or moral quality, we shall certainly place health as first among the characteristics of a good variety.

Next to health we rank good flavor. Some may sneer at the idea of flavor in a potato; but every variety has a taste peculiar to itself, as marked as in the different varieties of apples. That potato is most universally liked, which, like pure water, has little taste. Some varieties are bitter, like the waters of Marah; and it is a little singular that those who are addicted to the use of strong potatoes prefer them to the milder kinds, much as those who are accustomed to drink the muddy water of the Missouri complain of the pure spring water of New England as having no "body" to it. There is no accounting for tastes; but there can be no doubt that an unvitiated taste prefers a mild potato, as it does pure water. The flavor depends partly upon the soil where the potato is grown, and the material with which the soil is enriched. We have known a variety, grown in sandy loam, lightened with muck or leaf mold, mild and agreeable; while the same variety, grown in clay, enriched by fresh manure, became strong, and even bitter. The Carter is a standard potato for a mild, pleasant flavor; the Jackson White, a seedling from the Carter, is flavored much like its parent; and the Early Goodrich commends itself in this particular to universal favor.

Another characteristic of a good potato is its farinaceous quality. Possibly we might become accustomed to a soggy potato, so as to prefer it to a mealy one; but it will be some years hence, and after long and self-denying practice. Possibly the mealy quality can be carried to excess, so that the potato will fall to pieces in boiling, and will not have consistency enough to be chopped up, or broiled or fried in a second cooking. We have heard this objection made to the Dover. The first edition of it is good, light as sponge-cake; but it is almost impossible to warm it over and bring it on the table in a decent shape. As the first cooking is the more important one, and as the farinaceous quality is so desirable, there is little danger of cultivators paying too much attention to its development.

Form is another quality to which all potato growers should have an eye. A deep-eyed, hunch-backed potato may taste just as well as a smooth, well formed one; but there is great waste in cooking it, and the market value is and should be less. The Colebrook Seedling is a model in its form; a smooth, egg-shaped potato, with seldom an excrescence upon it. The State of Maine and the St. Helena are looked upon with great favor, as is many a belle, mainly for their good form. We may decry good looks, either in women or potatoes, as much as we please, still the stubborn truth will remain, that good looks first attract the eye, and find a market.

Productiveness is a recommendation to the character of a potato so obvious that it needs only to be alluded to. This quality does not originate solely with the soil, as some imagine, any more than does the fattening propensity of a pig consist solely in the swill-pail. The productiveness of an animal runs much in the breed, and it is much the same in the vegetable. Some varieties of the potato yield abundantly where others would sparingly. In the monthly report of the agricultural commissioner for December last, we find a table exhibiting the yield of the several varieties of potato grown upon the grounds of the department the past season, from which we learn that the greatest producer at Washington, as determined by one summer's trial, is the Albert, yielding 47 3-20 pounds for one pound planted; the next in rank is the Economist, yielding 43 10-22 pounds for one; the Early Goodrich 39 pounds, and the Harrison 32 13-15 pounds. The trial of one summer is not sufficient to determine accurately this question of productiveness, for, unaccountable as it may seem, one variety does well one season and fails the next, while precisely the reverse may be true of another variety. The Early Goodrich did not do itself justice the past summer, while the Colebrook Seedling, that failed the previous summer, has redeemed its character the present season. With us the greatest producers for a succession of summers are the Garnet Chili, the Harrison, and the Gleason, and these varieties have also the great merit of uniform size. The Early Goodrich has been a great producer, but, like the Northern Spy apple, while there are many large and good, there are also many small.

Other things being equal, we should give preference to an early and white potato over the late and red. The early potato is most likely to escape disease and frost, and comes into market when prices are high. Almost every season we hear some old fogy farmers, who have never heard of any other early potato than the Early June, say in July, "We do not like early potatoes, they are soggy; we prefer old potatoes till the new ones are ripe." This means they prefer the old, withered potatoes, with the starch dried out of them, to Early Junes, or Round Pink Eyes. To cure all such prejudices, it needs only a few doses of Sebec or Early Goodrich taken at dinner-time. One dose will generally suffice, but a week's application is warranted to cure. A dose of the Early Rose would perhaps be still more efficacious, but the Rose tastes too strong of silver, as yet, to be used as medicine. Dr. Holland, of *The Springfield Republican*, is the only man we know who has had much experience in eating the Rose potato, and he commends them highly, and well he may, for in eating two or three barrels he unwittingly ate as many hundred dollars. Editors are expected to know everything, and we hardly know how to excuse the Doctor for his ignorance of the market price of the Rose potato. Possibly he was writing his Kathrina while the potatoes were being consumed, and the editor was lost in the poet. If the Rose contributed to his inspiration, the world gained by his loss of the potatoes.

The prejudice against red potatoes may be a mere prejudice, but it exists, and we must make the best of it, and get around it if we can not overcome it. We know no reason why red potatoes should not be as good as white ones; neither do we know any reason why a red man may not be as good as a white man; but we all prefer to be white, and we all prefer white potatoes.

Avoid a deep-eyed potato. There is great waste in buying them, as we buy much air if we buy by the bushel. This may not be an objection to the producer, but we take it for granted all farmers are honest and wish to give a fair equivalent for value received. If potatoes were sold by weight, as they should be, this objection would be obviated, but still there would be great waste in cooking the deep-eyed tubers. Some of the deep-eyed potatoes are so good that we can afford to pocket these losses. The Garnet Chili is imperfect in this particular, but is too good a producer, and too healthy and well-flavored, to be discarded for this one defect. Moreover, it is the father of the Rose, one of the latest wonders in the potato world. As we can buy a bushel of Garnets as cheaply as one pound of the Rose, we prefer for table use the old block to the young chip, though we have no doubt the Rose will prove a great accession to the varieties of potatoes, especially as it matures a week or ten days earlier than the Early Goodrich.

We should not do justice to this subject of the varieties of the potato, did we not pay a tribute to the memory of the late Rev. Chauncey E. Goodrich of Utica, N. Y., who devoted more time and showed more zeal and skill than any other man in propagating the potato. For sixteen years he studied this subject most carefully, and he has left us a rich legacy in the results of his investigations. From some constitutional idiosyncrasy, Mr. Goodrich was unable to eat potatoes himself, which fact makes his persevering labors in studying the habits of the plant, and originating new varieties, all the more praiseworthy. As early as 1846 his attention was called to the potato disease. The result of his investigations was the conclusion that the causes of the disease were want of vigor in the constitution of the plant, the artificial mode of propagation by cuttings instead of the natural mode by seeds, the sudden changes and intensities of our climate, and the character of the soil. The constitution of the potato, he concluded, had thus become impaired, and the product of one year transmitted its want of vigor to the next generation, each becoming more and more enfeebled.

In 1848 he imported from South America, the original home of the potato, some of the native tubers, and from the seed of these began producing new varieties. In all he originated some 15,000 seedlings. These he divided into seventy-four distinct families. After four or five years' trial of the different seedlings, he rejected those whose health, yield and habits he did not like. Mr. Goodrich died in the midst of his experiments, but not until he had established in public favor the Garnet Chili, Early Goodrich, Cuzco, Calico, Gleason, and Harrison varieties, which now stand at the head of the list with all well-posted cultivators. These varieties can be cultivated with the expectation that, under ordinary circumstances, they will escape disease and yield remunerative crops of excellent quality. They will probably degenerate in the course of time, and a reproduction from seed of healthy parentage is the only mode of propagating the potato with the certainty of reproducing a healthy variety.

The Early Goodrich has not done as well the past season in some localities as formerly, but we have never yet seen a rotten potato of this variety. To insure its success, and indeed that of all the early varieties, planting must be done early in the season. So far as we can learn, those who have failed of producing good crops of this variety, have planted late. Early planting produces a greater amount of woody fiber and less of soft cellular tissue in the vines, as it grows more slowly in the cool weather. As a general rule the early planted crops of all varieties are more hardy than those planted late. The maturity of the crop is driven by late planting into extreme autumn and unfavorable weather, even should it escape the dangers of the hot, sultry days and cool nights of August.

It sometimes happens that extreme warm weather, with sudden changes, occurs in June, when the vines of the early varieties are in their most succulent state, and the tubers are approaching maturity. In this case they may become diseased, while the late planted, not much developed, escape and yield a healthful and bountiful crop. This is, however, the exception, and not the rule. We look for the weather that is most trying to the constitution of the potato, when the dog star rages, in the latter part of July and during August. The engorged state of the plant and its soft, vascular tissues, especially when grown in rich soil, render it liable to disease when the hot, moist days are succeeded by cool nights, or a sudden change of the weather checks the flow of sap. The cells may burst from an excessive flow, stimulated by heat, moisture and nitrogenous manure, or they may collapse by the sudden check of the sap by the cold. In either case putrifaction ensues. If the potato has great constitutional vigor, it may resist these changes. The Garnet Chili, the Harrison and Gleason seem to possess this vigor, and we trust the Rose has it also, but its character is not yet fully established. We have the past summer raised the Gleason on very rich garden soil, and while other varieties planted by their side rotted, the Gleasons came out sound and in great abundance.

The potato loves a rich soil, and large crops can be raised in no other, and one great advantage in planting vigorous varieties is, that we can plant them in such a soil. For many years after the disease made its appearance, it was supposed that little if any nitrogenous manure could be applied to the potato-patch, as it so greatly enhanced the tendency to rot, and we were content to raise light crops on poor, light soil. The yield fell off from an average of 300 bushels to the acre to less than 100. Since new and healthier varieties have been introduced, the yield is again on the increase, partly because we find that these vigorous kinds can resist the tendency to disease which manure induces. The Garnet Chili, one of the earliest, introduced by Mr. Goodrich, and one of the most vigorous, has evidently lost something of its original constitutional power, and in a hot, damp time, decays when planted on fresh, unfermented manure.

CHAPTER XXVIII.

POTATOES (CONTINUED): QUALITY OF SOIL, ETC.

THE soil best adapted to the potato seems to be sandy loam, well drained in case the subsoil is of clay. Clay soils, if the season is unfavorable, are peculiarly prejudicial to the health of the potato, as they envelope the tuber closely and prevent the access of air, light and heat. If the surface of the unripe tuber is kept constantly wet, as it is apt to be in a wet season on clay soil, decay will be likely to ensue, even when morbid matter has not been conveyed from the vine to the root, which seems to be the usual mode. The inverted sod of an old pasture is one of the best soils for potatoes. With a little well-rotted compost harrowed in thoroughly upon such a sod, to give the plants a good start, we have raised good crops upon comparatively poor soil. An old pasture contains much vegetable matter, and the tubers delight in the mellow bed which such a soil affords, and come out in the fall clean and healthy. We have also raised good potatoes in a mucky soil, apparently having little but vegetable matter in it. This can only be done in a dry season. In a wet summer the muck retains too much water, and has the same influence on the tubers as compact clay. Leached ashes should always be put in the hill with potatoes when planted on muck, to furnish the inorganic matter in which muck is deficient. A compost made of muck and leached ashes is one of the best possible manures for the potato. The muck makes the soil porous, and furnishes a bed in which the potato delights as much as our mothers formerly did in a feather-bed. Sufficient potash is left in the leached ashes to furnish this essential ingredient of the potato.

Sandy soils are often as much too open to atmospheric influences as clay soils are closed against them. Sand both heats and cools too rapidly, and feels the sudden changes of temperature which are so trying to the potato. Still, on poor sandy soils good crops of potatoes can be raised by the aid of muck and ashes. The perfect drainage and slow growth secure this result. The seed should be planted deeply and cultivated on a level, so that the tubers may be less affected by the sudden changes of temperature. We have known potatoes to rot as badly on sand as on clay, when planted superficially and hilled up in contracted hills. Hilling was formerly universally practised, but hills heat and cool more rapidly than a level surface, feel the effect of drouth more, and are now discarded in light dry soils. It was supposed that the tubers felt the influence of air more in the hills and had a lighter bed in which to expand, but potatoes should not be planted anywhere till a good bed is first prepared for them. The only good reason for hilling in a dry soil is that the potatoes are more easily dug. Diseased tubers will generally be found nearest the surface of the ground, and if the soil is washed off so as to expose them to the sun and air, they are ruined if they do not rot.

Whatever may be the character of the soil, it should be plowed deeply and thoroughly mellowed by the harrow. Deep plowing, deep planting, and frequent stirring of the soil with the cultivator, will place the crop beyond the contingency of a wet or dry season. If the soil is thoroughly drained and pulverized, so as to be light and spongy, it will allow the excessive moisture of a wet season to pass through it, leaving its enriching qualities for the nourishment of the potatoes, and in a dry time, will, like Gideon's fleece, absorb the vapor which always abounds in the atmosphere. The statement that a deep and mellow soil is best adapted to resist the extremes of moisture and drouth, may seem to some paradoxical, but facts abundantly verify it.

In case the land is not thoroughly drained, and is of a clay nature, inclining to be wet, we prefer broad hills or drills to level culture, as the potatoes will be less exposed to excessive moisture. Drills will give the greatest return, and if the land is sloping, should be made to run directly down the slope so as to afford partial drainage. We have heard the fear expressed that if drills run with the descent of the ground, the land would be liable to wash in heavy showers, but this is a mistake. With a furrow once in three feet, there can be no great accumulation of water in any one furrow. The frequent furrows scatter the water, much as Quimby's frequent points on his lightning rods scatter the electricity. Whereas, if the furrows run obliquely or transversely with the slope, the water will accumulate in the furrow till it rises to a sufficient hight to overcome the barrier of the drill, when it makes bad gullies, as the Yankees call the channel made by running water.

If potatoes are planted in drills, three feet apart, and the seed dropped at intervals of a foot, the cultivator can pretty much supersede the use of the hand-hoe. This should be run between the drills as soon as the young shoots make their appearance, to keep the ground mellow and open to atmospheric influences. One hand-hoeing may be necessary to eradicate the weeds growing in too close proximity to the potatoes to be exterminated by the cultivator. Otherwise we should never care to put a hoe among potatoes. By much waste of human vitality, the hoe may be made to pulverize the soil as well as Share's cultivator, but we have never seen it done, and should decidedly object to putting our muscles to such a strain when those of a horse can be obtained, and the work be better accomplished in a tenth part of the time. When it is desired to throw the mellowed soil in ridges, the side teeth of the cultivator can be taken out, when the long mold-boards of the cultivator will place the soil where it is needed. Nor should the cultivation be continued late in the season, for a new setting of tubers may be thus occasioned, which will be late and small, and will draw the nourishment from those set more early. In case the potatoes are planted early and the land is rich, as it should be, the tops will completely cover the ground by the first of July, keeping it shaded and moist, and smothering the weeds that may be struggling to live.

The question whether to plant large or small, cut or uncut tubers, has long been a mooted one. We are satisfied, both from our own observation and the testimony of others, that medium-sized tubers are better than large or small, and that they should always be cut lengthwise, leaving three or four eyes in each piece. We have raised good crops of potatoes from small tubers, and from small pieces with single eyes. The use of such seed for one year may produce no marked deterioration, but let this plan be continued for a series of years and degeneracy will surely follow. It will be found a penny wise and pound foolish policy. The use of the tuber is to furnish nourishment to the young shoot, and if a generous slice is planted the shoot comes up strong and healthy, with a broad leaf, and grows vigorously, over-topping the weeds. If a small piece or only a sprout is planted it starts slowly and feebly, and requires much nursing. When the seed of some rare variety costs a dollar a pound, the temptation is great to plant the sprouts only, and to plant successive sprouts from the same eye. This may answer a temporary expedient for money-making, but is contrary to the law of good seeding. We are confident the practice tends to the deterioration of the constitution of the potato. It is like stunting an animal in the early stages of its growth. Generous feeding afterward may apparently compensate for the damage done by the previous parsimony, still the constitution of the animal has received a shock not easily remedied, and will be very apt to show it in the next generation. Certainly if the process of half starving the young is continued for a succession of generations, we may expect a degenerate race of animals.

We know there is some hazard in drawing analogies between vegetable and animal pathology, but the causes of disease arising from poor nutrition, original want of constitutional vigor, and the changes of the weather, are much the same in vegetables and animals, and we are confident that one of the causes of degeneracy in the potato is the want of proper nourishment when only the sprouts or small pieces are planted. In these cases, invariably, the sprout is small, grows slowly at first, and the first leaves are small and shriveled, and if the weather is unfavorable, many of the sprouts die.

We know an experiment of this sort made the past summer with the Rose potato, in which three successive generations of sprouts from the same eyes were planted, the first in April and the two succeeding in May, and finally the tuber itself was cut up and planted. The sprouts were feeble, and many of them died, but by good cultivation yielded bountifully over one hundred fold. The gain of one year will, however, be more than balanced by the loss of constitution in the potato. In fact we fear the character of the Rose potato has already been injured by this excessive lust of gain, prompting to this injudicious mode of propagation. We know of some instances in which the Rose has rotted badly the past summer, whereas such a new and thorough-bred seedling, coming, as it does, directly from the Garnet Chili, one of the healthiest of Mr. Goodrich's varieties, and boasting of a descent from a Peruvian ancestry, should not rot under the most unfavorable circumstances. The objection to planting whole potatoes is, that we get too many stems together. It is like planting six or eight kernels of corn in one hill. There is not room for proper development of the seed. Such thick growth may answer for a forage crop, but when the object is seed or roots, the ground must not be overstocked. Three or four stems in a hill are better than more.

As large potatoes will manifestly furnish more nourishment to the young shoot, it may be asked why not plant the largest, and thus get a vigorous start? The objection to these large potatoes for seed is that their tendency is to reproduce large, overgrown, hollow-hearted tubers of coarser texture and flavor than the medium-sized. This was the objection to the Garnet Chilis on their first introduction. They were too large, often hollow, and not a first quality table potato till late in the spring. Subsequent cultivation from small tubers has greatly improved them in this respect, though at the expense of constitutional vigor. Such were the health and vigor of this variety on its first introduction into Massachusetts, some eight or ten years since, that we have seen some of the large specimens of the previous year's growth, cracking open in the cellar during the summer, and exposing from twelve to twenty young tubers of the size of marbles, that had grown to this size fed only by the air and the parent tuber. We have never seen a similar instance in any other variety. This may seem to some a fish story, but we are prepared to vouch for it.

The object in cutting the potato lengthwise is to secure the vitality of the seed end, and at the same time the nourishment of the butt end. It has been observed that the eyes, or buds, at the seed end start with more vigor than do the others, and hence some economical housewives have been in the habit of cutting off this end for seed, while preparing potatoes for the table during the winter. The practice lies open to the same objection as the planting of sprouts. There is not sufficient nourishment furnished the young plant from the potato itself. In the eye end there is concentrated more starch and more vitality, just as there is more sugar and more flavor in the bud end of the apple than in the stem end; but if we cut the potato crosswise, we lose the support which the butt end is designed to give to the eyes. We have found it an excellent plan, when cutting potatoes for seed, to put them into a barrel and sprinkle upon them a quart or two of plaster. If the barrel is well-shaken, the plaster will fasten upon each fresh-cut surface, absorb the moisture and prevent the ingress of air, so that the seed will be less likely to rot after being planted, and the plaster will also aid in furnishing nourishment to the young plant.

We often hear it recommended to change the locality of the seed yearly, and seed brought from the North is generally thought to do better than that from the South, while others maintain that it makes no difference where the seed comes from provided only that it be changed. We have no doubt there is such a thing as acclimating a vegetable as well as an animal. The climate, soil and seasons stamp themselves on the vegetation grown there, and we can readily see that a potato brought from the North will ripen in a given latitude at an earlier day than one brought from the South and accustomed to a longer period for maturing. Facts seem to favor this change of seed, and facts are stubborn things. The subject needs further investigation.

The time of digging must depend upon circumstances. If the crop is designed for winter and spring use, and the soil is dry, we should prefer to let the potatoes lie in the ground till the weather is cool enough to allow them to be immediately stored in the cellar. But if the soil is moist, and the crop shows a tendency to rot, it should be dug as soon as mature, and placed on some dry knoll, scattering with every half dozen bushels a quart of fresh slaked lime. Over the pile the potato vines may be thrown, and over the whole a few inches of dry soil, in a conical form, making a pit much like the charcoal pit. The lime checks the tendency to rot, and we have never known potatoes, thus treated, to fail of keeping well. Some recommend charcoal dust, instead of lime, and we presume it is useful, as it is an antiseptic; but we cannot recommend it from personal experience. When the weather becomes cool, the potatoes can be removed to the cellar or taken to market.

By all means dig in dry weather, and store the potatoes away as dry as possible, but with little exposure to the sun. The skin of the potato is of a corky nature, impervious to water, and designed to keep external moisture from the the potato and the internal moisture from evaporation, and if too long exposed to wet will sometimes rot, when the tuber must perish. A well-ripened potato, put up dry in the fall, will lose little weight during the winter, its skin preventing evaporation as effectually as does the tight cork of a bottle. In the warm weather of summer the starch is converted into sugar, and slowly evaporates through the pores of the skin.

All cutting and bruising of potatoes must be carefully avoided. They must be treated as things of life, and not like the stones, which can be tossed about without sensation. Every cut and every bruise increases the tendency to decay. The potato may not be quite as sensitive as the apple, and may stand more hard thwacks, but still every bruise breaks the cellular tissue and puts the vitality of the tuber to a hard test. The digging must not be entrusted to careless boys, or the potatoes will look sadly hacked. We have never seen any instrument for digging that will compare with an Irishman's shovel. Making a fulcrum of his knee, the Irishman runs his shovel under a hill and lifts potatoes and dirt together, carefully picking out and placing the tubers in the rear and scattering the soil about evenly, so that when the potatoes are harvested, the field looks as though it was prepared for a crop of wheat. Such a mode of digging is almost as good for the land as a thorough spading.

Potatoes that are by constitution and culture healthy, can be stored in large bins, provided the cellar is not too damp nor too warm. We are blessed with a dry cellar, situated on a gravel knoll, and have never known a potato, put into the cellar in good condition, to rot after it was stored away. The windows should, however, be left open as late in autumn as the frost will permit, and the temperature kept as near to the freezing-point as possible without exposing the vegetables to freezing. Every cellar should also be provided with a ventilator, running to the roof of the house, so that should any of the potatoes rot, the malaria may not poison the household. A simple hole in the chimney makes the best ventilation possible, as the hot air makes a strong draft, and the current will be forced from the first floor into the cellar and thence up the chimney, provided there is no more direct access to this great and best ventilator of the house.

In case the potatoes are wet by a sudden shower before being housed, or from any cause they are wet when put into the bin, it will always be safer to put a little air-slacked lime with them as they are stored away. A little dry dirt upon them does no damage, provided always it is sufficiently dry. A washed potato never keeps as well as one that is put directly from the ground into the cellar. Washing seems to remove a part of the integument which nature has provided to guard against the entrance of moisture and air to the flesh of the potato. We often hear thin-skinned potatoes praised, but they are apt to be of a delicate constitution, and consequently more liable to disease, so that, as Virgil says of the farm, "Praise a large farm, but cultivate a small one," we say, praise a thin-skinned potato, but plant those of a thick cuticle. As the potato is often kept six or eight months before finding a market, it needs a thick covering to protect its virtues from evaporating.

With all the care possible exercised in cultivating the potato, the varieties seem to decline with age. None of the old standard varieties can now be relied upon with certainty. The Carter, the Mercer, the Peachblow, may, in a favorable season and circumstances, yield a remunerative crop, but the chances in most parts of New England are against them. On the sandy soil of Cape Cod, where climate is so much modified by the sea breeze, with the ocean in close proximity on either side, we are told the potato disease is scarcely known. If so, the Cape can be put to no better use than growing potatoes. With muck or sea-weed mixed with the sand, no better soil or climate can be desired for the growth of this esculent. But those of us who live in the interior, especially those who cultivate clay lands, must look for new and healthy varieties. Would that the mantle of Rev. Chauncey E. Goodrich might fall on some worthy successor, and that his investigations might be carried on with all the nice accuracy and close observation which he exercised. The loss from the potato disease in England has been estimated some years as high as $50,000,000. In this country it has never been as great, but here it has caused serious alarm, lest this most valuable esculent should be entirely lost from among our vegetable productions.

This extreme anxiety has abated with further knowledge of the disease, and we feel confident that the potato, by more skillful culture and especially by the introduction of more hardy varieties, is destined to continue one of the leading crops of the country. In order to insure this, more attention must be paid to originating new varieties from seed. No tyro can do this successfully. There is such a thing as a thorough-bred vegetable, as well as a thorough-bred animal, and the principles of vegetable physiology are nearly as intricate as those of the animal economy. The balls for seed must be taken from vines whose tubers are known to be hardy, well-shaped, early ripened and largely productive, and with all care taken in the selection of seed, the cultivator will find that the potato sports into many varieties, much like our common fruits. The seed must be sown in the spring in a hot-bed, and when the season is sufficiently advanced the plants can be transferred to the garden or field. In the autumn the most promising varieties can be selected for further trial, and experience proves that the most hopeful at the end of one season often prove worthless in the course of further experiment.

It is only after four or five years' cultivation that the character of the new seedlings can be well ascertained, and when it is well established in the mind of the cultivator, the public are slow to believe it, so that the reputation of the potato is a work of many years; unless, like the Rose, it falls into the hands of speculators who blazon its merits for the sake of gain. After the labor of cultivating many thousands of varieties, Mr. Goodrich found only ten or a dozen in all respects worthy of general cultivation. No highly valuable seedlings were produced from old and diseased varieties. In the Garnet Chili, Early Goodrich, Gleason, Harrison and Rose, we have bases for still further improvement and every encouragement to hope for success. Mr. Goodrich has left us a rich legacy in these potatoes, and more particularly in the minute details of his experience, which he communicated to the public in the transactions of the New York State Agricultural Society for 1863.

We hope to see these experiments continued by some equally disinterested, indefatigable and skillful laborer in this department. Our agricultural college can do the state no better service than by originating good healthy and productive varieties of this esculent. With potatoes at $1.00 per bushel, as they now are in the retail markets, they would be an expensive luxury did not custom make them an indispensable necessity. So far as mere nutrition is concerned a poor man, at present prices, can much better afford to buy flour for his family than potatoes. If by the introduction of new and healthy varieties and an improved mode of cultivation, the average yield per acre can be raised again to three hundred bushels, then the farmer can better afford to sell potatoes at fifty cents than he now can for one dollar. We commend this subject to the attention of the board of agriculture, to the trustees of the agricultural college, to the farming community generally, and to all who own a potato patch.

NOTE.

With regard to the varieties of potatoes, we desire to record the results of further experience since the above lecture was written. The Early Rose fully maintains its character, both for early maturity and good quality. Probably no potato is more widely disseminated or gives such general satisfaction. The Harrison proves very productive, but the quality can not be said to be first rate. Still we consider it a great acquisition. It yields on good ground 400 bushels to the acre, and for late use is a good table variety. The Gleason is also very productive and very good. The Garnet Chili proves to be the most hardy of all Mr. Goodrich's seedlings, and is also productive and of good quality. Mr. Albert Bresee of Hubbardtown, Vt., who originated the Early Rose, has continued his experiments in producing new varieties and has been very successful. From the seed of the Garnet Chili he has secured, besides the Early Rose, the King of the Earlies, the Prolific, and the Peerless, all good varieties. The Early Mohawk, originated in Michigan, in 1866, from that old standard variety, the Peachblow, bids fair to do honor to its parentage. We must, however, caution our readers against too large investments in new varieties. The success of the Early Rose has given a great stimulus to the production of seedlings, and it is just as easy for potatoes as for men to acquire a paper reputation, but character is not so easily established. This comes only after fair trial, and until trial is made it is not worth while to buy potatoes at a dollar per pound.

LECTURE NINTH.

CHAPTER XXIX.

THE CORN CROP.

THE word corn is of Saxon origin and signifies all kinds of grain, as wheat, rye, oats, barley, etc. The word is, however, modified by the usage of different nations. When the Englishman speaks of his corn crop he means wheat, the Scotchman applies the term principally to oats, and in the United States we restrict its use almost exclusively to the leading grain of the country, which is maize, commonly called Indian corn, as it was the grain which the original settlers of the country found cultivated by the Indians. Botanists class corn among the grasses and give it the name of zea mays. Zea is a Greek word signifying life, and is applied to corn because of the great amount of nutritive matter which this grain contains. Maize in the Gaelic signifies food, and in the Livonic language in the north of Europe mayse is bread. Zea mays is, therefore, a very appropriate name for the grain which furnishes more breadstuff for man and more food for cattle than any other.

From the returns of the industry of Massachusetts for 1865, we learn that the number of acres under cultivation with Indian corn in this State, that year, was 67,588, and the number of bushels produced was 1,986,685, valued at $2,905,357. In 1855 the number of acres was 91,056, and the product 2,659,875 bushels, showing a decrease in the number of acres planted in these ten years of 23,468, and a decrease of production of 673,190 bushels. This is not because the farmers of Massachusetts love corn less, but because they love tobacco more.

The decrease of corn is also owing to the increased attention paid to the cultivation of grass, potatoes and roots, and in the neighborhood of cities and large manufacturing places to the increased area devoted to market gardening. Some have even argued that corn can no longer be raised with profit in New England, and that it is better economy for eastern farmers to obtain their supplies of this grain from the fertile prairies, and to devote our lands to more bulky products which can not be so easily transported, and which our markets more imperatively demand.

While we concede that there is some foundation for this view of the case, and that it is difficult to figure up large profits from an ordinary yield of corn in the East, still we should be very unwilling to see this leading staple of the country reduced to an inferior rank in the Eastern States. While it may not be profitable for the farmer to raise as an article for sale, as was formerly the case, still the forage is so excellent, and the grain raised in New England so superior to that brought from the West and South, and as its cultivation leaves the land in such excellent heart for succeeding crops, we contend that every farmer who has land adapted to this cereal should raise as much of it as may be needed for consumption in his own family and by his own stock. It will be found very handy to have around at all times of the year, and we should hardly know how to manage a farm without a crop of corn taking its place in the accustomed rotation.

Nor is our climate so poorly adapted to this cereal as some have imagined. It is one of the provisions of a kind Providence, that this most useful of all grains should have a wide range of latitude in which to grow, extending from the equator to fifty-one degrees on the north, and probably as far south, so that, making allowance for the high elevations within this range where it can not be grown, we are safe in saying that on most parts of the earth, where men do mostly congregate, corn can be raised in sufficient quantities for their support, and, what is contrary to the generally received opinion, the maximum production is nearer its northern than its southern limit.

Our western friends, whose boys can not be seen as they ride their horses in cultivating their corn-fields, can hardly be persuaded that our diminutive stalks can produce any grain; still the census of the United States shows that Vermont produces more corn on the average to the acre than any State in the Union, and the largest authenticated product from a single acre so far as we can learn, Massachusetts has the honor of having produced; so that we do not feel prepared quite yet for giving up corn as one of the leading staples of New England.

It does, indeed, require high manuring and much labor, and with a yield of forty or fifty bushels per acre it may only pay the expense of cultivation; but with one hundred bushels from an acre, which we can obtain with proper skill, there is a handsome profit. The statements of farmers differ widely in their estimates of the profits of corn, some making them large, others small, and others still showing a balance between the expenses and gains on the wrong side of the account; still the fact that very few farmers are willing to give up the raising of this cereal, and that most still cling to it as the leading hoed crop, proves that it stands high in public estimation.

As proof that the corn crop has not run out in Massachusetts, we desire to give the following statements: In the report of the Martha's Vineyard Agricultural Society for 1868, we find the award of the three following premiums on corn: first premium to Joseph Sylvia for 110 1-2 bushels per acre; second premium to John Davis for 109 1-4 bushels per acre; third premium to George D. Cottle for 108 1-2 bushels per acre. Mr. Sylvia's statement is as follows: "Soil, sandy loam. Crop in 1866–7, nothing. Manured with 40 loads of 30 bushels each to the acre; value of manure, $20; cost of labor per acre, $14; value of fodder $18. I have a field of five acres on which I put 200 loads of compost made from sea-weed and barn-yard manure, with five loads of night-soil. From one acre I harvested 110 1-2 bushels shelled corn. The land I bought last spring for $10 per acre well fenced."

Mr. Sylvia has the great advantage of sea-weed, which reduces the cost of his manure to the minimum of $20 per acre; but as an offset to this he has a barren sand to cultivate, and raises 110 1-2 bushels of corn, the value of which must have been $1.25 per bushel, giving, with the straw, the gross receipts from one acre of $156, and deducting the cost of cultivation ($34), a net receipt of $122.

This is doubtless an extraordinary yield under very favorable circumstances, but his competitors are only one or two bushels behind him. From the report of the Nantucket Society for 1868, we learn that Dr. Augustus Franklin, of that island, raised 73 1-2 bushels of shelled corn from an acre, which he valued at $95.55. Adding two tons of stalks, valued at $20, his gross receipts were $115.55, and deducting expenses ($69.20) the profits were $46.35. In the same report we notice our friend James Thompson makes the profit of his acre of corn, grown on the Nantucket sands, as $24.25. If these things can be done in the dry sands of Martha's Vineyard and Nantucket, what can not be done in the green-fields of the Connecticut and Housatonic valleys?

A full history of this important cereal has never been written. The impression prevails, generally, that the plant is of American origin, and is the greatest vegetable contribution that the New World has made to the Old. We have no doubt this impression is correct; still many naturalists contend that maize is of eastern origin. Bach; the first botanist who wrote of it, forty years after the discovery of America, asserts that it came from Arabia, and was called wheat of Asia. Fuchsius also declares that it came from Asia to Greece, thence to Germany, and was called wheat of Turkey. Much stress is also laid by the advocates of its eastern origin on the chart of Incisa of the thirteenth century. This chart describes a grain of a golden color and partly white under the name of meliza. Crescenzio describes the method of cultivating this grain, which is very similar to the mode now practised in cultivating maize.

The learned author of the "Flore d' Egypte," published by the order of Napoleon, says the description of the meliza of the East corresponds to maize, but that it can be equally well applied to the millet of India, the grains of some varieties resembling corn and varying from yellow to white. Some kernels of corn are also said to have been found in the sarcophagus of a mummy in Thebes, in 1819. If this is true, we can more easily believe that they were dropped there accidentally or roguishly, than to believe that they had lain there for two thousand years unmolested, especially when we consider that no picture or minute description of this grain has come down to us from Egypt, Greece or Rome. Herodotus does indeed speak of a species of wheat grown in Babylonia, the leaves of which were three or four inches in diameter and the return two to three hundred fold. This comes the nearest to a desription of the growth of Indian corn of any old record, but still the description will answer for sorghum or millet, as well as for corn, and it is more reasonable to suppose that sorghum or millet was the "wheat" that Herodotus intended to describe.

A Chinese writer of the middle of the sixteenth century describes a maize grown in China which corresponds with our Indian corn; but this was a hundred and fifty years after the discovery of America, and very possibly some of our native grain may have found its way to China in that time.

Notwithstanding the many authorities in favor of the oriental origin of maize, we have little faith in the theory; but whether it was known or not in Asia before the discovery of America, there is and can be no question that the Spaniards found it growing in this western world on their first arrival, and there is abundant evidence to prove that it was cultivated in America and formed the leading article of food centuries before Columbus landed on these shores. Ercilla, Torquemada and others, tell us that among other wonders the Spaniards found on their first setting foot on American soil, was a gigantic wheat with long stalks, called maize. The harvesting of it was celebrated with religious festivals, and it constituted the chief vegetable food of all the native inhabitants. It was esteemed by the Indians as more valuable than gold, and indeed in many cases constituted the medium of exchange, instead of the precious metals. A theft of seven ears of corn the Mexicans punished with death. They offered the first fruits of their corn to their goddess Centl, and the Mexican name of the plant signified "She who feeds us."

The Incas of Peru annually held a corn feast in the month of May, on an island in Lake Titicaca. One of the earliest of the Peruvian historians says the palace gardens of the Incas were ornamented with maize in gold and silver, with all the grains, stalks, spikes and leaves, and in one instance a representation was made in gold and silver of an entire corn field of considerable size, giving the maize in its erect, growing state, and life size, a proof both of the wealth of the Incas and their respect for the native grain of the country. In the old ruins of Central America are found paintings and statuary ornaments of maize, and it seems reasonable to suppose that similar remains would have been found in the temples of the Old World, had this valuable grain been known to the old Syrians, Egyptians and Greeks.

We have quoted the authority of some naturalists in favor of the oriental origin of maize, and it is but right that we should give the testimony of the learned Baron Humboldt on the other side of this question. He says: "It is no longer doubted among botanists that maize is a true American grain, and that the old continent received it from the new. On the discovery of America by the Europeans, the zea maize was cultivated from the most southern part of Chili to Pennsylvania," (Maine he should have said). "According to the tradition of the Aztecs, the *Toltecs*, in the seventh century of our era, were the first who introduced into Mexico the cultivation of maize, cotton and pimento. It might happen, however, that these different branches of agriculture existed before the *Toltecs*, and that this nation, the great civilization of which has been celebrated by historians, merely extended them successfully."

I will only quote a few words additional on this point from the journal of the Plymouth Pilgrims, respecting the first discovery of corn in Massachusetts in 1620. After giving an account of the first sight of land, and anchoring in the bay of Cape Cod upon the 11th of November, and of the signing of that famous compact which formed the Puritans into a body politic, an event styled by Bancroft "the birth of constitutional liberty in the world," the journal relates the adventures of the first explorers on Massachusetts soil, who landed upon the 15th of the month, and found the stubble from which the Indians had gathered the corn. Further on they came to where an house had been and four or five planks were lying together. "Also (the writer says) we found a great kettle which had been left by some ship. Here was a heap of sand newly made. This we digged up and in it we found a little old basket full of Indian corn, and digging further we found a great new basket full of very fair ears of corn, some yellow, some red, and others mixed with blue, which was a goodly sight. The basket held about three or four bushels, and was very handsomely and curiously made. After much consultation we concluded to take the kettle and as much of the corn as we could carry with us; and when our shallop came, if we could find any of the people and come to parley with them, we would give them the kettle and satisfy them for the corn. So we took all the ears and put a good deal of the loose corn in the kettle for two men to bring away. Besides, they that could put any in their pockets, filled the same, and the rest we buried."

This discovery and a subsequent one of ten bushels more, furnished the Pilgrims with seed for their first year's crop. The Indians afterward treated the Puritans at Nemasket (now Middleborough) with bread, called mazium, made from corn, and taught them how to pound the grain in mortars and make it into samp.

It is worthy of notice, in connection with this question of the original home of corn, that immediately on its introduction into Europe from America, its cultivation spread with astonishing rapidity where the climate was suitable for it. Unfortunately for England, her moist atmosphere and cloudy skies did not furnish sufficient sunshine and heat for the maturing of this most valuable grain. Had it been otherwise, who can tell what would have been its effect in revolutionizing British husbandry? We are confident of one thing, that had the climate of England favored the cultivation of corn as it does the turnip, the latter would never have attained its present relative importance. In France, Spain, Germany, Russia and Turkey corn immediatly commended itself for general cultivation. Why so useful a grain was not introduced into Europe before, and why it spread so rapidly when introduced from America, are questions which the advocates of an oriental origin for this cereal find it difficult to answer. France now produces from forty to fifty millions of bushels of corn annually, and Russia from twenty to thirty millions, and everywhere its cultivation is on the increase, except in some few restricted localities where other crops are found more profitable.

The increased production and consumption of this grain in the United States run up into such large figures as almost to be beyond comprehension. The estimate of Mr. Capron, our commissioner of agriculture, makes the product for the year 1868, 905,178,000 bushels, an increase of 137,000,000 bushels over the year 1867. This estimate does not include the Territories nor the Pacific States. In the latter, the climate unfortunately is not favorable for the production of this cereal, and it is considered of secondary importance. Only a few thousand bushels are annually produced in California, and the production of Oregon is still less. Illinois is the banner State for corn, yielding last year 134,363,000 bushels, about one-seventh of the entire production. Ohio formerly led the van in producing corn, but the march of the empire of this cereal is westward, and Illinois must look well to her laurels, or her younger sister Iowa will ere long bear the palm, as her production last year amounted to 65,332,000 bushels.

Notwithstanding this immense production, there is no danger of the market ever being overstocked. Corn has this great advantage over other cereals that are mainly raised as breadstuffs, that what man does not need, the stock will consume. The amount raised in the country is tenfold more than is necessary to furnish the entire population with breadstuffs, still the demand does not diminish, and the price on the prairies, owing to the increased facilities for transportation, has increased with the increased production. Railroads have almost annihilated distance, and brought producers and consumers within hail of each other, though thousands of miles apart.

A Massachusetts capitalist, a few years since, owning a farm in Illinois, upon which he had a tenant, was asked by the tenant what he should do with the corn, as he could only get an offer of twelve cents per bushel. He was told to make some rail cribs and stack it until a better market should offer. The better time not coming, the tenant finally wrote that, as the hogs were breaking into the cribs and the corn was diminishing, he should advise taking it to a market town on the river, where corn was commanding fifteen cents; but upon inquiry the capitalist found that the transportation would cost about all the crop would bring, and he wrote to his tenant to dispose of it in any manner he pleased, with this proviso, that the transportation should not cost more than what was realized from the sale. Those days of low prices and high freights have happily passed away never to return.

The great proportion of the corn raised in this country is converted into beef and pork before it is transported, and if Professor Gamgee's method of preserving fresh meat by sulphurous oxide gas shall prove a success, so that cattle can be slaughtered in Texas, Kentucky, and Illinois, and the carcasses can be transported to the East without the offal, and with no danger from putrefactive decay, corn must still further appreciate at the West, and at the same time beef-steaks, spare-ribs and mutton-chops come more readily within the reach of the consumers at the East.

CHAPTER XXX.

NATURE AND USES OF CORN.

OF all the grains used in fattening animals, corn stands at the head. Chemical analysis and the practical results of the best feeders agree in this. The chief peculiarity in its composition is that it contains more oil than any of the common grains. The analyses of corn by different chemists vary somewhat, and the grain itself doubtless varies in its composition, the properties slightly changing with different varieties, different climates, and different soils and modes of culture. Johnston, in his Chemistry of Common Life, gives the following as his analysis of Indian meal: Water 14, gluten 12, fat 8, starch, etc., 66. He makes four times as much oil in corn meal as in fine wheat flour, and two per cent. more gluten, or muscle-forming principle. In unbolted wheaten flour, the gluten is more abundant than in corn meal. The large proportion of fatty matter in the latter not only adapts it for fattening mature animals, but makes it more grateful to the alimentary canal, and, therefore, more wholesome.

It will be observed that the per cent. of starch in corn is very large. Some chemists give even a larger per cent. than Johnston, making it sometimes as high as 80, or four-fifths of the weight of kiln-dried corn. This large quantity of starch does not detract from the fattening property of corn, but rather adds to it, as starch is fat-forming rather than a muscle-forming principle, and its chemical composition is precisely identical with sugar, woody fiber and gum, each consisting of carbon 12 atoms, hydrogen 10, and oxygen 10. These substances are transformed by a mysterious process into each other in the growing plant, so that what is starch to-day, becomes sugar to-morrow, and woody fiber the next day. Fat or oil is also identical with starch and sugar in its chemical composition, and herbivorous animals must derive their fat in part at least from these substances.

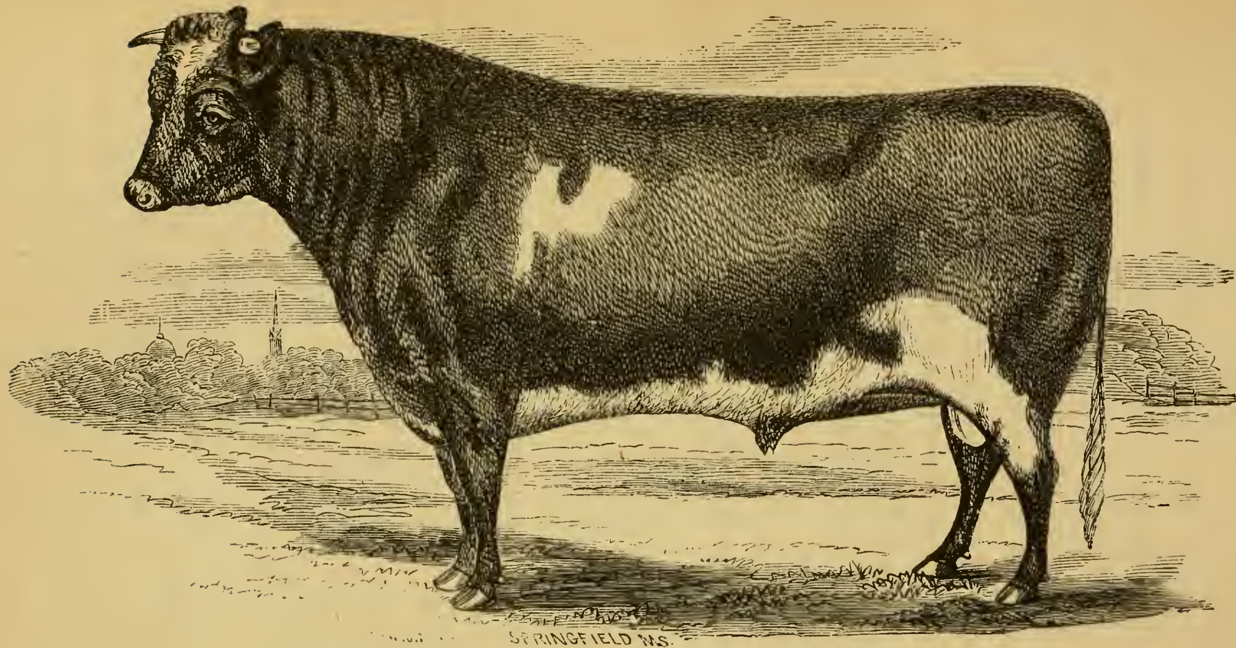
There can be no question, however, but that animals fatten more quickly when fed upon food that abounds in oil ready for immediate assimilation. All practical farmers know that cattle fatten most readily upon oil-cake, swine upon beech-nuts, and poultry upon meal and suet. The conversion of starch or sugar into fat in the animal implies a chemical change, though a very slight one, which imposes upon the vital principle a greater amount of labor than by the simple appropriation of the fat which exists ready formed in the food. The vegetable thus ministers to the animal, and lessens its labor by preparing beforehand the materials out of which the animal is to build up the fatty parts of its body. When the food does not contain a sufficient quantity of ready-made fat to enable the animal to perform comfortably its various functions, then it has the power to form an additional quantity from the starch or sugar it eats, but with some loss of vital energy. Thus the honey-bee makes wax, a kind of fat, when fed on sugar alone. All animals must have this mysterious power of transforming sugar, gum, starch, and in extreme necessity, even woody fiber, into a lubricating material for their bodies.

Now corn, as we have seen, contains 8 per cent. of its weight of oil ready formed for assimilation by the animal, and of starch, sugar and gum that can be converted into fat, 66 per cent., in all 74 per cent. of fat-forming principles. Its 12 per cent. of gluten renders it also a good food for producing muscle, though in this respect it is inferior to oats, which contain 18 per cent. Oats should, therefore, be fed to young, growing stock when the object is to develop muscle, but when we wish to put on fat, corn is the grain. Many of the seeds, as flax and cotton, may be richer in oil than corn, and are, therefore, more fattening; but of the class of seeds that we call grain, corn stands preeminent in feeding, and especially in fattening properties.

It is worth while to notice that science and skillful practice agree in the value and uses of corn, and indeed are seldom at variance in the more important economies of life. The groom, who, perhaps, has never seen or heard of an analysis of corn and oats, prefers the latter to feed to his fleet horse, because, as he says, they furnish more muscle. But when the horse is to be fattened or used only on slow draft, then corn is preferred to oats. The observing farmer, though he may not know the use of gluten in the grain, prefers oats for his young stock and corn for his stall-fed cattle. He may not be able to give the reason of his preference, but such is the result of his observation. The Irishman, who goes on to the mountain of a cold winter's day to chop wood, selects his food with as much discrimination as science could do it for him. He desires cabbage and pork, not because he knows the cabbage contains nitrogen and the pork carbon, but his nature craves these articles to supply the demand for muscular strength and animal heat. On the same principle, the Englishman at work in his hay-field chooses for his food bread and cheese, and science can make no better choice for him.

Corn, however, not only contains starch and oil, fitting it for fattening purposes, but it also contains a large per cent. of nitrogenous substances, variously named albumen, casein and gluten, which make muscle, and therefore render it good food for growing stock and working horses and cattle. The amount of this muscle-forming property varies with the different varieties of corn. Johnston, as we have seen, made it 12 per cent. In the hard, flinty, yellow corn of New England there are from 13 to 14 per cent., while the Sioux variety contains 16 per cent. As the fattening property is, however, the leading characteristic of this grain, it must be fed to young animals with discrimination. The abundance of oil in corn makes it of a laxative nature, and care must be exercised lest much of the food pass through the animal imperfectly digested, and when fed injudiciously the great heating tendency of corn meal may produce fever and permanent disease of the viscera.

Many also confound fat with muscle, and the purposes which these serve in the animal economy. Much corn and other food is therefore injudiciously used from ignorance, not only of its composition, but of the effect produced on the animal. Fat gives no working power. An excess of it is a great impediment to locomotion. Its first purpose seems to be to lubricate the animal machinery, enabling the joints and muscles to play freely without friction with each other, and less danger from external injury. In respiration a portion of the fat is converted into carbonic acid and passes off into the air. When severe exercise is taken, the fat passes off rapidly through the lungs, so that very few animals in a state of nature, being constantly on the move in search of food, have much accumulation of fat. In a domesticated state they are more quiet, and,



AYRSHIRE BULL, OWNED BY WILLIAM BIRNIE, ESQ., SPRINGFIELD, MASS.

with an abundance of fat-forming food, the lubricating and heat-forming material becomes in excess of the wants of the body, and is shown in the roundness and plumpness of the parts. This is by no means an index of health, as many suppose, but rather indicates an abnormal condition and a tendency to disease.

For this reason we should not advise excessive feeding of young animals with corn. We do not desire these animals to be fat, only to be in good growing condition, and hay and roots will keep them in this condition with less unnatural forcing than corn meal. If any grain is required, oats will serve the purpose of development better than corn. The round and sleek look of the animal, produced by feeding corn meal, is a great temptation to the young feeder to give it in excess, but the health and comfort of the animal are of more importance than good looks. If the food contains too little fat-producing material to lubricate the muscles and joints and to supply the natural waste by perspiration, then the store of fat which has been accumulated in time of plenty is drawn upon, and leanness ensues.

Nature is provident, and in a normal condition of the animal system a sufficiency of fatty matter is carried about in the body not only for the day's necessities, but a store is kept on hand to meet any unusual demand, which the food may not be able wholly to supply. This surplus stock of fat may be increased at the will of the feeder, by keeping the animal quiet and warm and giving an abundance of fat-forming food. Corn is the highest type of this food, flaxseed-meal or oil-cake excepted, and when the muscle-forming and bone-forming qualities of corn are taken into account, corn has no rival as food for stall-fed animals, and no country in the world has the facilities for producing so cheap and so good meat as ours, for nowhere does corn grow with such luxuriance as in its native American home. It may be added that nowhere is the consumption of meat so great, and the demand fully keeps pace with the supply.

The analysis of the ash or earthy part of corn is of importance as showing what it demands of the soil, and what it can furnish for building up the skeleton of the animal. In one hundred parts of the ash we find silica 38.45, potassa 19.51, phosphate of lime 17.17, phosphate of magnesia 13.83, phosphate of potassa 2.24, carbonate of lime 2.50, carbonate of magnesia 2.16, sulphate of lime and magnesia .79, silica found mechanically 1.70, alumina and loss 1.65. The leading constituents of the ash of corn, it will be noticed, are silica, the phosphates and potassa. Silica is one of the most abundant products of nature, being the chief ingredient in sandstones, quartz and sandy soils. There is no lack of this leading constituent of corn ash in the soils of Massachusetts, except it may be in some very restricted localities where clay or muck are found in great purity. As one hundred pounds of corn leave when burned less than two pounds ash, and as only three-tenths of this ash is silica, there is no danger of the corn crop ever exhausting the stock of this material. The phosphates and potash are less abundant, but may readily be supplied when deficient by bones and wood ashes. Sulphate of lime has often been found to work wonders on the corn crop in particular localities, but it does not enter largely into the composition of the ash of the grain, being less than one per cent.

The importance of any one ingredient in the composition of an article is not measured by its amount. The amount of iron that enters into the composition of our bodies is an insignificant fraction, but without it we should look lifeless and feel lifeless. Besides entering directly into the composition of corn, plaster acts most beneficially on the crop by absorbing the gases necessary for its growth, and giving them out as the corn may make drafts for the same.

It has been much disputed among practical farmers whether the cob contains sufficient nourishment to pay for grinding, some contending that it does, and others maintaining that mingling cob meal with corn is as bad as diluting milk with water. The analysis of the cob throws some light on this subject. Dr. Jackson of Boston has made many analyses of cobs, of which we give the two following. The first is Burr's improved sweet corn. Cob, short and thick and quite large in proportion to the depth of kernels, weighed 480 grains. The dry powdered cob, gave of dry oil, .179 per cent., sugar .065, extractive matter .242, gum and albuminous matter 3.257, and oil 3.743. The ash gave potash .2581 per cent., soda .2104, silica .125, phosphate of lime .0521, phosphate of magnesia .0279, oxide of iron .0416, phosphoric acid .0292, chorine .0292, carbonic acid and coal .0812. The analysis of Dutton corn gave the weight of the dried cob at 830 grains, containing of fixed oil .249, sugar .333, gum and albumen 2.7. The ash of the Dutton cob did not differ essentially from that of the sweet corn. The late Dr. Emmons of Williams College gives us an analysis of the corn cob, not specifying the variety, from which he obtained 2 per cent. of gluten and gum, and in all over 15 per cent. of nutritive matter, and concludes that the grinding of the cob with the corn is the most economical disposition of it. "There is," he adds, "another reason for the practice, in the increase of the bulk of the food, for it is unsafe to feed concentrated nourishment to grass-eating animals." As the millers charge the same toll for grinding cobs as for the pure corn, the economy of grinding must depend much upon the kind of animals to which the corn is to be fed. If young and growing, the cob must, in earthy matter, furnish much material for building up the frame; but if the animal is mature and needs to be fattened, pure corn is preferable. To horses doing light work, cob meal may also be fed with profit. We need more accurate observation and experiment on this point, and more exact and careful statements of the results attained. It seems desirable that some more economical mode of grinding the corn and cob together may be devised, as both science and practice agree in assigning to it more or less nutritive value, and the great amount of ash the cob furnishes it is certainly desirable should be retained for incorporation into the animal skeleton. By grinding the corn and cob together, the labor of shelling the corn is also avoided.

CHAPTER XXXI.

VARIETIES OF CORN AND ITS CULTIVATION.

THE varieties of Indian corn are almost innumerable. Its wide adaptation to different soils and climates renders it also liable to great changes in its character. On the shores of Lake Superior we find it a shrubby reed; on the bottom lands of the Mississippi it towers up in colossal proportions; in Canada we find dwarfed stalks and tiny ears, with compact, yellow, glossy kernels; in the South grow the mammoth ears of the white and yellow gourd-seed varieties. As found growing wild in some parts of our country, each kernel is surrounded by a husk of its own, and enjoys individual sovereignty, while in its confederate relations the thick husk of the ear throws its ample protection over the whole. When under cultivation and the corn attains to the dignity of civilized life, the individual husk always disappears, and the corn trusts itself to the protection furnished in its confederate relations.

Almost every locality has its favorite variety of corn originating there, yielding its thousand fold, and generally named after the originator. Thus, in Berkshire County, we have the Tillotson corn, which originated with Mr. Tillotson of Lanesboro, who prided himself on his premium crops. The great secret of his success lay in his selection of the seed. Every year, before his corn was harvested, he went through his field selecting the most perfect and the earliest ripened ears from those stocks on which grew the largest number of ears. Doing this year after year, he finally established for his corn a reputation for early maturity and great productiveness. Mr. Tillotson did for his corn just what Bakewell did for his sheep; he made it thorough-bred. The same improvement was made on a more extended scale by Mr. Baden of Maryland, the originator of the famous gourd-seed variety which bears his name. He says he began with the common corn of Virginia, which had hardly two ears to a stalk; selected for seed from stalks having the most ears only the sound and ripe, of deepest and best color and least cob, rejecting the irregular kernels at both ends; followed this course twenty-three years—several before he saw much improvement—when he took the seed only from stalks having at least four ears. Some have borne ten.

Mr. Baden thus succeeded in establishing a variety of corn of which he thinks he can raise twice as much as of any other. One hundred and twenty bushels of shelled corn of this variety, it is claimed, have been raised from an acre, and ten bushels of ears will yield six bushels of shelled corn. The stalks are twelve to sixteen feet high, ears six to eight feet from the ground, and the grain excellent. Of course it is not adapted to the latitude of New England, but what Mr. Baden has done for Maryland, some other patient and persevering man can do for Massachusetts.

The variety which has enjoyed, perhaps, the most extensive reputation in New England is the Dutton corn, so called from its originator, Mr. Salmon Dutton of Vermont, who introduced it in 1818. It is very early, being ready for harvest from the last week in August to the second week in September. It is a twelve-rowed variety, with a large cob, but produces abundantly, and two bushels of ears yield one and three-eighths bushels of shelled corn. The Dutton is a seedling from the Golden Sioux of Canada, and is rich in oil, and therefore well adapted for fattening purposes.

King Philip is another popular variety in New England, so called from being procured of the tribe of Indians of which he was chief. It is eight-rowed, and the ears are longer, the kernels larger and the cob smaller than the Dutton, but the kernels are not so compact on the ear. It is a very early and productive variety, but thought by many not equal to the varieties of Canada origin for fattening purposes. A small variety known by the name of Canada corn ripens in ninety to one hundred days from planting, and though the stalks are dwarfish in size, yields an abundant crop of heavy corn, abounding in oil, and is a popular variety in the northern and mountainous regions of New England, where the shortness of the season renders other larger and later varieties uncertain. It can be planted compactly, and has been known to produce 75 to 80 bushels of grain of a highly nutritive quality.

It is not a little singular that we who are accustomed to the yellow, flinty and oily corn of New England, should prefer it to the white southern gourd-seed, and esteem the latter insipid and only fit for horses. Northern corn in a northern market always commands the higher price. Precisely the reverse of this is true at the South. Our southern friends consider our little yellow corn as strong and heating, fit only for brute beasts, while their own is sweet and savory. In this view it must be confessed they are sustained by the inhabitants of the Middle States and by Englishmen. In England the white corn always sells for one or two shillings a quarter more than the yellow. New Englanders do not object to this, as we raise no corn for export.

The southern corn may make a whiter looking bread, and to those who like it is just the corn for them to raise, but there is no question but that the corn grown in higher latitudes is richer in oil and saccharine matter; and as for the color, that is a matter of taste. Some may prefer the pearly white, and others the golden yellow, and if so, the true mode is to agree to differ. By a wise provision of Providence, the southern corn, abounding, as it does, in starch, is best adapted to the inhabitants of a warm climate; while the northern, having more oil, is equally well fitted to keep up the temperature of the body of those who live in a colder region. That each latitude should prefer its own production is not, therefore, wonderful. If the object of raising corn is to make starch, then the southern corn is best; but if the object is to feed to stock, to furnish gluten for muscle and oil for fattening, then both analysis and trial favor the heavy, flinty grained varieties of the North.

The peculiarities of sweet corn are, that it contains little starch, much sugar and gum, and a large amount of phosphates, and in the process of drying the sugar parts with its moisture, and the corn shrivels. The varieties of sweet corn are legion. It is so great a favorite for a table vegetable, that the competition is great among market gardeners to raise early and choice varieties. The period of maturity has been so much hastened by the selection of early seed year after year, that some of the dwarf varieties furnish developed ears in six to eight weeks after planting. What has been gained in maturity, however, has been lost in size. Burr's improved is one of the best sorts for a general crop, and for late planting the Stowell evergreen stands unrivaled.

Not only is sweet corn good for the table, but for feeding young stock; the large amount of phosphate of lime it contains renders it the best of food, furnishing them the material from which to make bones. The stalks of sweet corn also are as much better for cattle as the corn is for the table. If the stalks of both the common and sweet varieties are fed to cattle at the same time, they will pick out the sweet and neglect the other till hunger compels them to eat. We have fed the stalks of sweet corn to cows for a time, and then changed to those of the common variety, which the cows would smell of, and then look up as if asking, "Have you nothing better to offer us?" The flow of milk is also much better from the sweet corn fodder. When corn is sown merely for the purpose of raising fodder to be fed out in a green state, as the pastures fail in August, we should advise sowing the Stowell evergreen solely. It is, however, so succulent that it is difficult drying it for winter fodder, and is most economically used directly from the field in the summer and autumn.

We must not omit, in speaking of the varieties of corn, to allude to that little favorite, pop-corn, which furnishes so much amusement and healthy nourishment for the children. As an article of food, easily digested, it is well worth raising by every family that owns a garden. Pop-corn contains its oil in little subdivided cells in the horny portion of the grain. When heated the oil is converted into carbureted hydrogen gas, the same that is used for lighting houses, and as it explodes every cell is broken, and the grain turned inside out, making music for the urchins which they prefer to that of the piano. Children are always fond of it, and the amusement which it furnishes of a long winter's evening adds not a little to the comfort of the home circle, and whatever contributes to make home pleasant is certainly worth cultivating.

Much as has been done in the way of improvement in the varieties of corn, the margin for further improvement is still great. A perfect corn for New England has not yet been reached. We need a variety of great hardiness, that will resist the extremes of wet and dry, hot and cold, to which we are exposed,—one that will mature early and still furnish a large ear, with a small cob, a large heavy grain, thickly set upon the ear. Whoever will do for the latitude of New England what Mr. Baden has done for that of Maryland, will show himself a public benefactor.

We can not expect a growth like that of Tennessee, where they boast of stalks over twenty feet in hight, looking like saplings, and yielding ears containing thirty-six rows; but we can have a variety adapted to our short season, that will yield more remuneratively than any we have at present, though we will give the farmers credit for selecting their seed corn with more care than any other seeds which they sow, and it is to this careful selection that we attribute the excellence which the corn crop of New England has ever maintained relatively with other parts of the country. While the average production of Virginia per acre is 18 bushels, and the average of the whole country is about 25 bushels, the average of New England is 36.

The soil best adapted to the growth and perfection of corn is a deep, rich, sandy loam. In such a soil the roots penetrate to a great depth, and the plant grows with wonderful rapidity and luxuriance. Its broad foliage enables it to draw much of its support from the air, and if the soil abounds in the mineral elements it needs, and is permeable to heat and air, the crop is very sure of being remunerative. A hard, clay soil, retentive of moisture and consequently cold, is uncongenial to corn, and must be drained before corn can be grown upon it successfully. At the same time it may be said that this plant has great flexibility of character, and adapts itself to all climates and soils. It is a gross feeder, and is not particular about the table on which its food is spread, provided only there is an abundance of food. There is scarcely any soil that can not, with suitable culture, be made to yield large and profitable crops. Unlike other cereals, it can not be over-fed, nor will its foliage be increased by high manuring at the expense of the grain.

Where it is practicable select a rich, sandy loam, with a heavy turf, the older the better, and plow not less than eight inches deep, and deeper still unless you bring up too much of the subsoil. One or two inches of the subsoil brought up each year to be ameliorated by the action of air and light, will do no damage to the growing crop, provided a plentiful supply of manure is furnished, and in the course of a few years, a shallow soil may be thus converted into a deep and mellow one. If the soil is a stiff clay loam the plowing is best done in the fall, so that the freezing and thawing of winter may break down the clay and render it more friable. The absorbing power of clay enables it during the winter to retain much of the fertilizing matter brought down from the air by the snow. In no case must a clay soil be plowed while wet either for corn or any other crop, as it bakes into hard lumps, which no subsequent culture through the summer can pulverize thoroughly.

The manures best adapted to the corn crop must vary with the character of the soil. In general it may be said that barn-yard manure contains all the elements which this and all other crops demand. At the same time it must be conceded that many soils are deficient in the phosphates and other earthy matters which corn demands in large quantities, and that these can be supplied more cheaply than by means of barn-yard manure. It often happens that a few dollars spent in ashes, plaster, or phosphate of lime, will answer for the corn crop as well as many loads of manure from the barn-yard.

One of the most valuable manures for corn is found in the pig-pen, especially where the swine have been corn-fed. This is rich in phosphates, and, indeed, in all the elements which the corn originally contained; as, in fattening swine, the carcass being already well developed, the oil and starch are the main compounds in the food which the animal needs for assimilation, and the balance are rejected so far as they are not required for sustaining the waste of the body. If, therefore, the manure of the pig-sty is composted with muck, leaf mould or other carbonaceous matter, we have all the elements in a very available form, and in the right proportion which the corn crop demands. The same is the case with the manure of stall-fed oxen where corn is the main feed. The principle may be made general, that wherever corn is the leading feed, the manure of those animals should be reserved for special application to the corn crop.

Experience has shown that the hennery is another source of manure specially adapted for corn. The manure of birds has this great advantage over others, that the liquid and solid excrements are combined. It is particularly rich in nitrogen and saline matters, and, mixed with a little plaster and muck, and a handful dropped in the hill at the time of planting the corn, it gives results sometimes so large that they are scarcely credible.

The question whether to plow the manure under, or to keep it nearer the surface of the ground, is one about which practical farmers are much divided. The prevailing custom of former years in New England has been to cart the manure from the barn in the spring, dump it in little heaps about the field, and spread and plow under as soon as the weather will permit. Much of the manure is in rude lumps and unbroken masses, strangely contrasting with the fine roots and fibers through whose minute mouths the nourishment must enter to support the growing corn.

When this same land is plowed the succeeding autumn or spring, we have often noticed, on clay lands especially, these lumps of manure very little changed by their six or twelve months' sojourn in the soil. Where the land was in good heart, and a sprinkling of fine manure was placed upon the surface or in the hill to give the corn a start, we have known good crops of corn raised by this wasteful mode of manuring. We are glad, however, to say that the more economical mode of composting manure, cooking it and reducing it to a fine state, and placing it nearer the surface where the rootlets can more readily avail themselves of it, is coming gradually into favor. The finer the manure is made the more easily it is dissolved in water, and the sooner it passes into the circulation of the plant. Both the soil and the fertilizer require to be thoroughly pulverized and intimately blended. This can not be done with the manure buried in lumps at the depth of six or eight inches.

Another disputed point among farmers is whether to select the seed from the tip, middle or butt ends of the ears. By an experiment of one year made on the farm of the State Reform School at Westboro, while under the care of the Massachusetts Board of Agriculture, it was decided that the seed from the butt end of the ear gave the greatest return in corn and stover, then the seed from the tip, and last and least was the return from the middle seed of the ear. Another experiment recorded in the report of the Massachusetts Board for 1858 gives the greatest return from the seed of the tips. Mr. Baden, however, in perfecting his famous corn, rejected both the tips and butts for seed, and there is no question that the majority of the testimony is in favor of this mode. The tips may answer for seed for a year or two, and little if any diminution of the crop follow; but if this practice of planting tips only were followed for a succession of years, we should expect deterioration, much as occurs in the potato crop from planting only small potatoes for a series of years. If only the irregular kernels at the butt ends should be planted year after year, we should expect finally to see irregular rows running through the whole ear, just as we expect to find irregular teeth in the mouth of a child whose ancestry, for a succession of generations, have had irregular teeth.

The advantages attending a discriminating selection of seed are well established by the uniform results of practice; and it seems unaccountable that any intelligent cultivator can be indifferent to a matter of so much importance. The law that seed should produce after its kind was stamped upon nature at the creation, and if the farmer plants inferior grain, he must make up his mind to harvest an inferior crop. The difference between a large and remunerative crop, and a small and unprofitable one, may be entirely due to the difference of seed. We have as much faith in thorough-bred seed as in thorough-bred stock; and one of the wants of the times is some one who will carefully collect and propagate the best seeds of corn and other grains, for a series of years, till their characteristics are as well established as are those of a Durham heifer or a Cotswold sheep. We commend this subject to the attention of our friends at the Agricultural College.

As to the time and mode of planting and cultivating corn, we can only say that the time must be determined by the temperature of the weather, and not by the day of the month. It is of the utmost importance that the seed should germinate speedily after it is planted, and that it should receive no check in its growth. From the 20th of May till the 1st of June is the corn-planting season in most parts of Massachusetts. On warm, sandy soils it may be planted at an earlier period, but in all cases the temperature of the soil must be 58° (Dr. Emmons says 60°), or the seed will not germinate, and in a few days will rot. We are satisfied that much corn is injured by being planted at too great a depth. If covered with three or four inches of earth it germinates more slowly, and when the plant has grown three or four inches above the ground it is apt to remain stationary for a few days, while the roots make a change of base. The lower roots die, and new lateral roots are sent out an inch or two above the germ, and not till the latter roots are firmly established does the plant grow with luxuriance; and the check it has received has a permanent dwarfing effect. From the experiments of a careful observer, we learn that corn planted at the depth of an inch came up in 8 1-2 days; 1 1-2 inches, 9 1-2 days; 2 inches, 10 days; 2 1-2 inches, 11 1-2 days; 3 inches, 12 days; 3 1-2 inches, 13 days; 5 1-2 inches, 17 1-2 days. In the latter case the plants were very feeble, and died after a short struggle for life. The depth of planting must be determined by the character of the soil. The conditions of germination are heat, moisture, air and absence of light. In a light, sandy soil, if planted only an inch deep, in a dry time, there might not be moisture sufficient for germination.

Our fathers, following the Indian example, planted in hills, and in cultivation drew the dirt around the stalks so as to form a conical or convex hill. There is no question but that more corn can be obtained by planting in drills, and the practice of the best cultivators favors keeping the ground as level as possible. If the earth is piled up around the stalks, they send out new roots, making another change of base, and thus retarding the maturity of the crop. The cultivator must be run between the drills often enough to keep the weeds down and the soil mellow and open to atmospheric influences. After every shower a dry crust is apt to form on the surface of the soil, which is an impediment to the entrance of dew and air, and should be broken by the cultivator.

The mode of harvesting corn is another disputed point among practical farmers, but the more common practice of New England to cut up the corn near the roots, when the ears are partially glazed, is justified both by the theory of the circulation of the sap and by careful experiment. The late Judge Buel of Albany, one of the most careful experimenters, was a strong advocate for cutting up corn by the roots, not only as furnishing more and better stover, but better grain. The late Henry Coleman of this State, another careful observer, says, that of three apparently equal rows in a field, the one cut up by the roots gave 9 5-8 bushels of corn, while the two that were topped gave respectively 7 6-8 and 7 3-8 bushels. Another farmer of this State, finds, as the result of a careful experiment conducted with a reference to ascertaining the best mode of harvesting corn, that by cutting the stalks above the ears there was a loss on an acre of twelve bushels three and one-half pounds, besides the loss on the stalks.

In conclusion, we say we deprecate the idea of the farmers of Massachusetts giving up the corn crop, and substituting for it roots, cabbages, or tobacco. Roots are good in their place; cabbages are good; tobacco we know nothing of from personal experience, but we agree with Whittier in the conclusion of his beautiful song;—

> "But let the good old crop adorn
> The hills our fathers trod;
> Still let us for his golden corn
> Send up our thanks to God."

LECTURE TENTH.

CHAPTER XXXII.

THE ROOT CROP.

WE have hesitated whether to direct your attention in this lecture to the minor cereals, or to consider that more neglected branch of agriculture, the root crop. Fully believing that the best farming is that which will give the greatest sustenance to animals, and that 1200 bushels of mangold wurzels on an acre are better for stock than 40 bushels of oats, and 1000 bushels of turnips better than 30 bushels of barley, and 800 bushels of carrots better than 20 bushels of rye, we have concluded to speak a word for these roots. There is no danger that the grains will be neglected. Custom sanctions the culture of grains, and custom is a powerful law, especially with an agricultural community. Since Ceres committed to Triptolemus her chariot drawn by dragons, in which by her command he traveled over the earth distributing grain to the inhabitants, the Cereals have been looked upon as the special gifts of Heaven to farmers, to be cherished with the utmost assiduity. We do not mean to say that the farmers of New England worship Ceres, or believe that she brought the grains down from heaven, as did the old Greeks and Romans, who thought it impious to change the processes of culture which Ceres had taught them, lest they should appear to derogate from her wisdom and thus incur her displeasure. But it does seem as if some shadow of the old delusion has come down to the present day, for in no art is it so difficult to give currency to new ideas and new modes of progress as in agriculture.

Roots have as good a claim to a divine origin as wheat or barley. Triptolemus did not, indeed, carry them in his chariot, and the old Greeks knew but little about them, the more is the pity. The Egyptians had their leeks and onions, which the children of Israel lusted after, when they were in the wilderness, but the long catalogue of vegetables which now minister to our health and comfort, and should minister to the health and comfort of our domestic animals, were unknown to the ancient nations of the earth, and are slow in making their way into general use in modern times.

Still they are good gifts of Him whose wisdom made them all, and should be received with thanksgiving. We can hardly see how the ancients managed to live without turnips, beets, parsnips, and, more especially, without potatoes. A blessed discontent would have arisen among them, had they not lived in blessed ignorance of these roots. Still it was two hundred years after the introduction of potatoes into England before they came into general use in that country, and they are now comparatively little used in Southern Europe.

In warm climates fruits may take the place of roots as an article of diet for men, and the cattle may browse and graze during the winter and not suffer for the want of succulent food; but in the cold climate of New England, where cattle must be housed for nearly six months, it is a great cruelty, as well as a wretched economy, to restrict them to hay for this length of time. Neither can grain, on the supposition that we can afford to raise it for stock, supersede the use of roots in the animal economy. The health of the animal demands a mixed food, of which the succulent roots should constitute a part, not only to furnish nourishment, but to keep the system in a relaxed and at the same time in a vigorous condition.

We have no objections to feeding our domestic animals some grain if we can afford it, but the quantity of grain grown in New England is small, and becoming beautifully less. By the monthly report of the Commissioner of Agriculture for January, 1869, we find the average product of oats per acre in Massachusetts for 1868 was 24.1 bushels; of barley, 20.1; of rye, 16.1, and of corn, 37. Even where grain is fed to stock, the cooling, antiseptic influence of roots is necessary to keep the animal in good health. For fattening purposes we make no claim for roots as being equal to corn, and to assert, as some have, that a bushel of carrots is equal to a bushel of oats for horses, shows ignorance of the relative nutritive properties of the two substances. The equivalent must be in their medicinal, not in their nutritive, effect. But when we consider that we can raise eight hundred bushels of carrots on an acre where we can raise only fifty bushels of oats,—that is, sixteen times as many carrots as oats,—we may well consider whether the roots are not the more profitable crop.

Mr. William Birnie of Springfield, an extensive breeder and feeder of stock, never fails of raising a large quantity of roots. He is an accurate observer and a close calculator, and if roots did not pay, we may be sure he would have discontinued raising them ere this. Mangold wurzels are his favorite root. He reports raising in 1859, on 2 1-2 acres of land, 3,166 bushels, or 95 tons, of this root. This gives 1,266 bushels, or 38 tons, to the acre. The cost of growing and harvesting these was 6 1-2 cents per bushel, when stored in the cellar, according to an accurate account of labor, fertilizers, etc. In 1862 Dr. George B. Loring reports raising on 1 1-8 acres, 1,800 bushels or 48 tons of the yellow globe mangolds, at a cost by accurate account of 9 1-2 cents per bushel. The same year he reports raising 750 bushels of Swedes turnips per acre, at a cost of 7 5-6 cents per bushel.

Still, it must be confessed, notwithstanding these isolated cases of successful culture of roots, their general culture throughout the State has not made the rapid progress that was expected when Daniel Webster came back from his mission to England with his glowing accounts of the turnip crops of that country. By the returns of the industry of the State for 1865, we learn that only 3,134 acres were that year devoted to the culture of turnips, and only 527 acres to carrots. It would seem that only the progressive farmers are cultivating these roots. We are confident that the great majority depend solely upon dry hay to keep their stock through the winter, and, judging from the looks of the herds in the spring, we are equally confident that the cattle have a sorry time of it.

We have great faith in good hay. It is the staff of life for all domestic animals. They rely upon it as man does upon bread, but we should be very loth to be confined to a bread and water diet; neither should we be willing to restrict our animals to hay and water. It takes them half the summer to recover from the effects of a deprivation of succulent food during the winter. We hardly know how to account for the slow introduction of roots in New England as a part of the winter food of stock. We do not like to attribute it to ignorance or prejudice. The Yankees are generally quick to see where the golden current runs with most depth and velocity, and to steer their boat in that channel. We are inclined to attribute the slow introduction of roots to the force of custom. Our fathers left England before the general introduction of turnip culture into that country, and brought from thence the custom of feeding hay as the sole reliance of stock during the winter,—a custom much better adapted to the mild climate of England, where the plow runs every month in the year, and comparatively few of the cattle are housed.

It is well known that England had reached the limit of her ability for supporting animals by hay alone, when her attention was turned by Lord Townshend to the increased capacity of the island for sustaining stock by the culture of turnips. This idea was ridiculed, and he was stigmatized with the name of Turnip Townshend. Truth, however, triumphed over ridicule, as she is always destined to do, and now it is scarcely an exaggeration to say that the power of England is based upon her iron, her coal and her turnips. Since the introduction of root culture, her capacity for carrying stock has doubled, and, of course, the quantity of manure has doubled, and a new stimulus has been given to every branch of agriculture. As roots appreciated, hay and grain also increased, so that in England, to-day, the average product of wheat to the acre is 36 bushels, while in New England the average for this grain in 1868 was less than 10 bushels. The sobriquet of Turnip, given to Lord Townshend in scorn, will ever cling to him as an honor. Now 3,000,000 of acres are devoted in England to the cultivation of turnips, and the crop is estimated to be worth $200,000,000.

We know it is said by some that the foggy atmosphere of England favors the cultivation of turnips, and prohibits the raising of Indian corn, and that could this favorite cereal of America, so excellent for its feeding qualities, be raised in that country, we should hear less of turnips.

There is some foundation for this conclusion, and we have no desire to disparage corn. Next to grass, it is the main-stay of our cattle, and has enabled our farmers to have roast beef on their tables each day in the year, if they desired it, and for fattening swine it is seemingly indispensable. Though not placed by Ceres among the grains in the chariot of Triptolemus, it is none the less a gift from heaven to be received with gratitude and cherished with all care, and we can never think of our English cousins as being deprived, by their lowering skies, of this luscious vegetable on their tables, and of this golden grain for their stock, without a feeling of compassion. Still, England, without the ability to raise corn as a general field crop, can show the best herds of cattle that are to be found in the world, and her roast beef and mutton-chops are unsurpassed by any corn-growing country. It must be acknowledged there is virtue in turnips and good hay to make good cattle and good beef, and the question for the New England farmer of to-day is, whether he can not increase his stock and consequently his profits, we will not say by raising less corn, but by raising more roots.

We are aware that the verdict of the majority of the farmers, as evinced by their practice, is against the roots; but, so far as our observation extends, the most intelligent and successful raise them and find great advantage in it. The most juicy and tender beef we have ever made, was fattened mainly on turnips and early cut hay, and at half the expense the same would have cost us if fattened by hay and grain. The most skillful breeders and feeders with whom we are acquainted, recommend, both for growing and mature stock, a mixture of roots with the winter feed.

Where milk is the object in feeding, roots should certainly constitute a part of the feed. The idea of making milk from dry hay alone is simply preposterous, certainly when the grass is cut, as is too often the case, after the formation of the seed, and the sugar and starch of the stems and leaves have been converted into woody fiber. For farmers to require their cows to make milk from such hay, is as bad as for the Egyptians to compel the Israelites to make brick without straw. If cows furnish milk in such unfavorable circumstances, they must do it at the expense of the tissues of their bodies, and must come out in the spring as poor as the lean kine that appeared to Pharaoh in a dream, coming up from the waters of the Nile, "poor and very ill-favored and lean-fleshed, such as I never saw in all the land of Egypt for badness." Their counterparts for badness may never have been seen in all the land of Egypt, but if they were any worse than some we have seen in Massachusetts, they could hardly have crawled up the banks of the river.

Cows can give milk just as well in winter as in summer, but in order to do this they must have warm stables and succulent food, and in no way can the latter be furnished so economically and successfully as by roots. Meal, made into a thin mush, may answer the purpose and gives a richer milk, but it is more expensive, and is not so healthy a food as June cut hay, fed in connection with roots. Cows will continue their milking qualities for a series of years better with this simple diet than when fed with the more stimulating corn meal. A little meal in connection with the roots may be advantageous, as the laxative nature of the roots will counteract the heating tendency of the meal, and the latter will serve to keep the animals in good flesh.

It is objected sometimes to roots that they contain from 80 to 90 per cent. of water. It is true that they contain this large amount of water, but this is no objection to their use. Most of the natural food of all animals contains a large per cent. of water, and where it is not naturally present in sufficient quantity, water is added to prepare it for digestion and assimilation. The dry flour from which we make our bread contains 16 per cent. of water and 84 per cent. solid matter, and when it is made into bread we add 50 per cent. more water; so that, with every 150 pounds of bread we consume, we take 66 pounds of water, and we still think it very dry food, unless we have a cup of water or tea with which we can dilute it as we eat. Lean beef contains 78 per cent. of water and blood,—full as much water as is contained in the potato, which has only 75 per cent. water. Eggs also contain 74 per cent. of water,—only 1 per cent. less than the potato, and 9 less than the carrot.

Milk, another highly nutritious and acceptable form of food, contains 87 per cent. of water, as it comes fresh from the cow; how much it contains when it reaches consumers varies with circumstances. All the fruits, which are so grateful to the stomach and are so easily digested, and on which the inhabitants of tropical climates mainly live, are largely composed of water. Plantains contain 73 per cent.; plums and other fleshy fruits, 75 per cent.; apples, strawberries and other small fruits, 80 per cent., while melons contain over 90. Now, experience shows that all this water is essential to our health, and if at any time we take what we call dry food, that is, food in which less than one-half is water, we require, besides the saliva, to wash it down and assist in its digestion, some accompanying fluid.

We have the highest scientific authority for saying that the most wholesome food is that which is largely diluted with water; but the universal practice of men is sufficient testimony on this point. As our bodies are composed of three-fourths water, it is absolutely essential that the food which nourishes these bodies should contain, or be accompanied by, a similar proportion of liquid; and when the liquid is contained in the food, it is generally more palatable and nourishing than when added extraneously. Thus a juicy apple is always more acceptable than a dry one, which requires a little water to wash it down; and a piece of meat which has been roasted or broiled till the natural juices are all evaporated, becomes a mass of dry fiber, and is about as unpalatable and indigestible as so much leather. The objection, therefore, to roots, that they contain a large amount of water, is a mere prejudice. The same objection might be urged with still greater force against white clover, which, in the opinion of most practical farmers, is the perfection of summer food for cattle, and still it contains only a little over one-half as much nutritive matter as the Swedish turnip.

Very possibly, also, there are floating through the juices of all these succulent plants certain chemical agents, too minute and refined for any chemist's tests, which render them peculiarly acceptable to the animal system. We know that each has a flavor peculiar to itself, which renders the vegetable pleasant or disagreeable as tastes may differ, but to analyze these flavors, and to account for their different refreshing and stimulating effects, is asking too much of science in its present stage of development. The fact, however, that the smell of a rose often does good like a medicine, and that the flavor of new-mown hay stimulates the workers in the hay-field with a feeling of unusual strength, cannot be denied. There is something in the juice of a peach which often refreshes the invalid more than mere nutrition could do, and our soldiers tell us that nothing was so grateful to them while in the tented field as vegetables. From their scanty and hard-earned wages, they were often glad to pay a dollar apiece for onions and potatoes.

That the inferior animals have something of the same craving for fresh vegetable food, is manifest from the greediness shown for it, when confined in their stables. A miser never looked on gold with a more covetous eye than a cow exhibits when she sees a turnip, after having been deprived of esculent food for a time. Whether, therefore, the amount of nutrition in roots is sufficient or not to pay for the extra labor of their production, we consider the question settled that a merciful man, who has regard to the health and comfort of his animals, will feed them some roots. But on the farm, as everywhere else, mercy and thrift are allies, and never go counter to each other. We contend just as strongly for the nutrition of roots as we do for their medicinal virtues.

We have the authority of Johnston for saying that the dry meal made from turnips is quite equal to that of Indian corn for feeding stock, abounding as it does in gluten, starch and sugar. The gluten furnishes the material from which muscle is made, and the starch and sugar are designed to lay on fat and support respiration. The only respect in which turnip meal is inferior to corn meal, is in the amount of oil ready prepared for assimilation by the animal; but this defect is more than compensated by the superior amount of muscle-forming material, which is nearly twice as much in dry turnip meal as in corn meal, rendering the former the superior food for growing stock, when fat is not the object aimed at in feeding. Attempts have been made in England to substitute turnip meal for wheat flour in the manufacture of bread, but it has been found impossible to eliminate the peculiar turnip flavor which to most palates is so disagreeable.

It must not be inferred from the almost total absence of oil which analysis gives in the roots, that they therefore contain no fattening properties. The eight per cent. of starch and sugar which is the average found in them in their natural watery condition, and the eighty per cent. of these substances found in the dry meal, furnish a good supply of fat-forming material, which is only inferior to that found in corn and flaxseed meal, inasmuch as it must be chemically changed in the animal into fat, a process which we know but little about, but which is doubtless performed at some expense of vital energy. These deductions of science are not at variance with the conclusions of observing, practical feeders. The Englishman keeps his young stock in a good, growing, healthy condition through the winter by feeding roots and straw, and when the animals are mature enough to be converted into beef, he substitutes hay for the straw and winds up with a little oil-cake.

And here let me say in passing, that the age of maturity when the fat should be laid on is not when neat stock is at two or three years of age, as many of our farmers suppose. A great mistake is made in this country by turning over to the butcher young, growing stock, two or three years old. Such beef is immature. The muscles are undeveloped. The natural tendency of the animal at this age is not to put on fat, but to grow, to convert its food into bones and muscles, with only fat enough to keep well lubricated, and make locomotion easy, not cumbersome. The food of the animal, when young, should be of such a nature as to stimulate this growth; and we can never expect our roast beef to compare favorably with that of England, till we cease killing so much immature stock.

The practice of our farmers in feeding and sending to the shambles so many two and three-year-olds is wasteful in the extreme, and cannot be too severely condemned. It arises from a haste to be rich which leads men into a snare. Where one dollar is saved by this premature slaughter, two dollars are lost. Daniel Webster, who is as good authority on the constitution of the ox, as on the constitution of the state, said no ox was fit to be slaughtered till five years old. Till then they should be kept growing, and for this purpose roots and hay were the proper food.

It has been proved, by actual experiments in feeding, that 300 pounds of turnips are equivalent in nutrition to 100 pounds of English hay. Now, as we can raise 18 tons of turnips per acre where we can raise two tons of hay, it follows that an acre will produce three times as much nutrition in the form of turnips as it does in hay. It may be thought by some that we have put the average yield of turnips too high when we name 18 tons per acre, but it certainly is no higher in proportion than the average quantity of hay, which is really less in Massachusetts than one ton per acre. We should be very sorry for any one who undertook to raise Swedes, who did not get 20 tons to the acre, and we are equally sorry for that numerous class who raise less than two tons of hay per acre.

Another great objection we hear made against the cultivation of roots, is the amount of labor their culture demands. We would like carrots for our horses and beets for our cows, say the moderate farmers, but we do not like to get down on our knees to weed carrots in the summer, and lifting beets out of the cellar in winter is work. It is very true that there is work in raising and feeding roots.

We know nothing great and good that can be accomplished in this world without work, and the greater the good, the greater the amount of effort required to secure it. Those who undertake to go through the world on downy beds of ease, generally find their beds are made of thorns instead of down. Something for nothing we are continually looking for, but never find, unless it is in speculation, which is not legitimate business, and even then what we grasp as substance generally proves a shadow. There is labor in making hay, though much less now than formerly, thanks to the inventors of mowing-machines, tedders and horse-pitchforks; but still it will not be contended that the labor required for raising a crop of turnips is three times as great as for raising a crop of hay, whereas the value of the turnips is at least three times that of the hay.

This objection to roots, when stripped of all disguise, amounts simply to a want of enterprise, the vis inertiæ of humanity which crops out among farmers occasionally as well as among other folks. These same persons, who object to roots for their stock, will raise potatoes for themselves, though the cost of their production is one dollar per bushel. It is not pleasant, we grant, to bow down before carrots and spend the live-long day in weeding and thinning them. We know from experience that it makes the back ache, and we are ready to excuse old backs from this service, as boys can perform it more easily than men, as their muscles are more supple.

Another objection made to roots is that they exhaust the land; that a grain crop does not follow turnips as well as it does corn, when the same amount of manure has been applied to each. We are ready to grant this, but what does it prove? The turnips have exhausted the land more than the corn, simply because the turnips contain more nourishment. We can not have something for nothing. We can not raise 1000 bushels of turnips upon an acre, and feed them simply on air. The analysis of the ash of turnips shows that it is composed of potash 36.98, soda 6.76, chloride of sodium or common salt 7.85, magnesia 3.61, lime 11.14, phosphoric acid 9.74, sulphuric acid 12.43, silica 3.43, with a little iron and chloride of potassium. These substances cannot be furnished by the air; they are of an inorganic, earthy nature, just such as animals require for building up their muscular and bony systems, and instead of complaining that roots exhaust the land, we should rejoice that they do so—that they are the medium for converting this inert earthy matter into animal life. We might as well complain that the miners of California, by exhuming 30 or 40 millions of gold annually, had exhausted that State. The roots only do what the gold-miners have done, put into circulation the wealth that is hid in the bowels of the earth.

This potash and soda and phosphorus are of no use so long as they lie buried in the soil, and the farmer who wishes to keep them there acts the part of the miser who buries his gold in the ground, instead of putting it in circulation to stimulate production and commerce, and thus increase the comforts of life. We know that turnips demand for their successful culture much phosphate of lime; but this is just what bones are made of, and when we get the phosphorus into the turnips, we are pretty sure of its finding its way into the animal; and if more of it found its way to the brain, where it is also greatly needed, that organ would be stimulated into more active exercise.

As a compensation for the exhaustive effects of roots upon the soil, we ought to say that they also return much to the soil. An extensive breeder of sheep, who is also an extensive feeder of roots, once said to us: "I don't think my roots save me much hay. They give my sheep such an appetite that they eat about as much hay with roots as without; but I get large, healthy lambs, large clips of wool, and piles of manure." In these "piles of manure," as well as in milk, muscles, bones, brains and wool, comes in the compensation for the exhaustion of the land. Point us to the farm on which a few thousand bushels of roots are annually raised and fed to stock, and we will point you to one where there is no deterioration of the soil. If turnips impoverish the soil, why has not England been impoverished by the cultivation of this root for more than a century? Swedes turnips were introduced into England about the year 1750, and into Scotland in 1766, and their cultivation in these countries has steadily increased since, and the improvement of the soil has kept pace with the increased production of this root. Belgium has raised roots for a still longer period, and her mode of agriculture furnishes a model for all Europe, and, indeed, is the highest type of agriculture in most respects to be found in the western march of civilization. The soil of Belgium, so far from deteriorating under her system of root culture, has steadily improved, and she supports, to-day, the largest herds and the greatest population to the square mile of any country in Europe. How does she do this? is the pertinent inquiry. It is by devoting every fifth acre to the cultivation of roots. A Belgian farmer with 40 acres of land calculates to feed 20 cows.

Not the least of the benefits to be derived from the cultivation of roots is the deep tillage, thorough enrichment and perfect pulverization of the soil they require. The long tap-root of the carrot can not luxuriate in a six-inch soil, with a hard clay subsoil under it. We have watched the growth of roots in such a soil, and at the first start they often show well, but when in the latter part of the summer the rootlets reach the subsoil, then the bilious look of the crop gives unmistakable evidence of having run against a snag, and its progress is checked as suddenly as that of a steamer on the upper Missouri when it strikes a sand-bar.

There is no use in trying to raise roots in a soil which is not thoroughly drained, deeply plowed, richly manured, and well-pulverized and aerated. When these things are attended to, the profit is great, and the benefit is spread over many years; and we confidently expect that when the roots receive that attention in New England which their importance demands, we shall see a general elevation in every department of agriculture. Cattle must certainly fare better, and with the big piles of manure must come larger crops. We hope the time is not far distant when the State returns will not shame the farmers of Massachusetts, by reporting the average product of hay, at one ton per acre, and wheat at ten bushels, and corn at thirty-seven. The cultivation of roots must have a tendency to hasten the coming of this good time.

CHAPTER XXXIII.

CULTURE OF ROOTS.

IN a brief lecture we have not space to go into the details of the cultivation of roots. We must content ourselves with giving general principles and making suggestions. The three principal roots raised in this country for stock are beets, turnips and carrots. Parsnips are also excellent, but their cultivation involves more labor, and the return is less. Of the three kinds named, we are inclined to put the beet first, not because it contains more nourishment than the Swedes turnip, but because our climate, certainly away from the coast, is more favorable to its production, and the crop is larger and more sure. In the moist, cool climate of England, and more particularly in Scotland, the turnip still maintains its supremacy; but in our warm and dry summers the mangold-wurzel is taking the lead. The beet has also the advantage of imparting no bad flavor to the milk and beef of the animals to which it is fed, and another advantage still of keeping later in the spring.

What kind of roots we shall raise must be determined somewhat by the animals to which they are to be fed. So far as our experience goes, we prefer beets for cows and swine, turnips for fattening cattle, and carrots for horses. Dr. Loring (from whom we are always loth to dissent) prefers turnips for horses; but when we have placed carrots and turnips together before horses, they have always chosen the carrots, and their instinct is a pretty sure test of what is most congenial to them. We have never known a horse to refuse to eat carrots, but we have had to teach them to love turnips.

Of the varieties of the beet the mangold-wurzel stands at the head for feeding purposes. The sugar-beet is not so great a producer as the mangold, but as the latter is not fit for use till January, it is often advisable to sow sufficient sugar-beets for fall feeding. Swine eat them greedily, and fatten upon them quite rapidly. When beets are raised for family use, the mode of culture is very different from what it is when they are raised for stock. For the table we desire a small beet, full of sugar, and to secure such they must be cultivated on a sandy soil, not highly enriched. For making sugar, the French manufacturers pay a third more for beets grown on such a soil than for those raised on stronger land richly manured, and they often cut off the part that protrudes out of the earth, which they feed directly to stock, reserving only the lower portion for manufacture into sugar. Of course, beets raised for the family can grow in close proximity. When they are raised for stock, the stronger the soil the better, and they must have elbow room. They are gross feeders, and there is no danger of the land being too highly manured. Both nitrogenous and saline manure are requisite for a large crop.

The analysis of the ash of the mangold gives, besides other salts in less proportion, 23.54 per cent. of potash, 19.08 of soda, and 24.54 of common salt. The ash of the leaf gives a still larger per cent. of salt. An average crop of 20 tons of mangolds will carry from the soil 80 pounds of potash, 60 of soda and over 100 of common salt, beside what is carried off in the leaves. The inference from this analysis is that mangolds must be grown in rich clay loam, for a sandy soil seldom contains much soluble saline matter, and that wood ashes, with common salt added, should constitute a part of the enriching material. Another inference is that the leaves must not be discarded as worthless. They make most excellent food. If left to perish on the land, their saline matter is, indeed, returned to the soil, but it is far more economical, that the stock should derive the first benefit from them.

Farmers have been slow to appreciate the value of leaves, either as food or as manure. They are always rich in phosphates, and the animals that feed on leaves never want material to make a large frame. The moose, that formerly browsed in the forests of New England, supported a large amount of bones, and in the Museum of Comparative Zoology at Cambridge may be seen the mammoth skeleton of the mastodon, an animal that evidently subsisted on the leaves and branches of trees, and his jaws and teeth were evidently designed to crush and grind some woody fiber in connection with the more tender shoots.

The ash of the straw of all kinds of grain is richer in saline matter than is the grain itself, and the conclusion is evident, that growing stock, whose frame-work we desire to build up, should be fed with grasses and roots, never neglecting the root tops. Mangold leaves are greatly relished by milch cows, and they give increased richness to the cream. By carefully conducted experiments at the Albert Institution in Ireland, in 1857, it was found that 40 quarts of milk, produced from rye grass alone, gave three pounds and five ounces of butter; produced from mangold leaves and pasture, the same amount of milk gave three pounds fourteen ounces of butter, and from mangold leaves alone the yield of butter was four pounds.

Very similar results will follow the feeding of the leaves of cabbages and all the roots. The testimony of all farmers, who have been induced to experiment upon feeding the leaves, is united upon their great nutrition, and science exactly accords with this practical testimony. Boussingault gives us an analysis of the roots and leaves of mangolds, and, while the root gives only 1.66 per cent. of nitrogenous or muscle-forming matter, the leaves give 4.5 per cent. For making bones the advantage is still greater with the leaves. They must not, however, be picked from the plant till they have accomplished their special and valuable functions. They serve so good a purpose in feeding, that the temptation is (particularly in the case of cabbages) to strip off the leaves prematurely, and thus deprive the plant of its lungs and kill it with consumption. When the leaves begin to droop and turn yellow, which generally occurs in the latter part of September, they may be removed without damage.

There are many varieties of mangolds, as there are of all our cultivated crops, produced by artificial or natural hybridization, but they may be reduced to these six: The long red, the long yellow, the long orange, and the red, yellow and orange globe. Which of these varieties should be cultivated will depend somewhat on the character of the soil. If this is a deep, strong clay loam, or of a peaty nature, the long varieties will give the greatest return; but if it is shallow and sand predominates, the globes are preferred. The globes also have the advantage of containing the greatest amount of matter, with the least surface for evaporation and injury, so that they keep later in the spring; but Mr. Birnie of Springfield, who is the most extensive feeder of mangolds in the country with whom we are acquainted, assures us that his long reds uniformly keep well till the first of June, which is as late as we wish to keep any roots.

The variety is not of so much importance as the seed. We are satisfied that more root crops have failed from the want of good seed than from any other cause. The temptation is great to seed-growers to use their old stocks, and to save the seed from all the umbels, the late and dwarfed as well as the early and plump. We do not suppose the seed-growers and the seed merchants are sinners above all other men, but there have been some cases of gross ignorance or carelessness or cheating (call it by which name you think is right) in these trades, which have resulted in great loss to the farming community. We were called upon once to act as umpire between a large number of farmers and the seedman from whom they had purchased Swedes turnip seed, the product from which all ran to tops, producing no roots worth harvesting. On investigating the case we found the seed-raiser had a field of Swedes turnips, which by some inherited defect or some sport of nature (probably the former, as nature does her work generally in earnest), proved to be an annual and produced seed the first year.

Not being willing to lose all his labor, he carefully saved this seed for sale, and reaped, as he supposed, a good harvest. This was profitable to the seed-raiser, but was destructive to all the purchasers of the seed, as not one in a thousand produced a decent root. As might have been expected, all ran to tops, which, however good for fall feeding, left nothing for winter use, and the calamity which should have been confined to a single field was unwittingly spread over a hundred.

We can not expect to raise good mangolds, or good roots of any kind, without good seed. The law that plants should produce seed after their kind, was promulgated in Eden, and time has only served to show its absolute certainty. We are more and more convinced with every year's experience that there is such a thing as thorough-bred seed, and to secure it we must take the same pains that we do to secure thorough-bred stock, propagating only from the most perfect plants and not allowing these choice specimens to produce a multitude of umbels, but by picking off the lateral shoots, to compel the roots to throw all their nourishment into the perpendicular and most vigorous stocks. By so doing, we get a small quantity of seed, but what we do get is large and plump, and well calculated to give the succeeding plant a good start in the world.

The seed can not, however, be called thorough-bred, till this process has been continued for a succession of generations, and its character firmly established. It is by this careful propagation that our friend Gregory, at Marblehead, has succeeded in establishing the reputation of his mammoth cabbages. When the character of a seed is once firmly established, there is danger that by a little carelessness it may be lost. Perpetual vigilance is the price of character for men and seeds.

Next to the importance of selecting good seed in raising mangolds and other roots, is the necessity of a thorough preparation of the soil by deep tillage and liberal manuring. Mangolds are peculiarly a root for good, strong clay loam, but they will grow almost anywhere if the soil is enriched, made deep, and thoroughly pulverized. We have known good crops raised on greensward, plowed the previous autumn, but their natural place in the rotation is after corn or potatoes; and the field intended for them should be plowed in the fall either with a subsoil plow or one with a trench attachment which loosens the subsoil, but does not bring it to the surface, and the land should be thrown over with a rough furrow, leaving as much surface as possible for the ameliorating influence of the winter's frosts, snows and winds.

When dry land appears in the spring, the field should be thoroughly harrowed with Share's coulter harrow, and again plowed, running the plow crosswise with the furrows of the previous autumn, when the harrow must be kept in motion till the requisite degree of pulverization is obtained. The seed should be sown in drills, 30 inches apart, and should be put into the ground early in May, immediately after the soil has been freshly stirred, that it may receive the benefit of a moist surface and of the spring rains. It is important that the plant should receive no check in the early stages of its growth. A stunted plant recuperates as slowly as does a stunted animal. At least six pounds of seed will be required to the acre, as it is easier to eradicate the superfluous plants than to transpose them. The most vigorous plants must be selected for maturing, and from eight to ten inches space be left between them, and be sure to remember Cato's third maxim in agriculture, "Keep down the weeds."

Cato's second maxim also, "Manure liberally," must not be forgotten. As to the kind of manure we are not so particular as in the quantity. There is no doubt, however, that all the root crops affect a mineral soil. Their saline constituents are abundant and must be derived from the soil. The taste of common salt can be distinctly discerned in the leaf of the mangold, and an application of six or eight bushels of salt to the acre will be found highly beneficial to this crop. Any refuse salt will answer the purpose. Our practice has been to secure the refuse fish and pork brine from the grocers, which costs nothing but the cartage, and add it to the compost heap. We decidedly prefer composted manure for roots. It is finer and more available for the nutrition of the plants, and we do not care to have it buried more deeply than can be done by the coulter harrow.

Barn-yard manure of course contains all the elements of food which roots require, and is especially well adapted for growing them, if the stock has been fed with roots. Still, as much of the phosphate of lime and other saline matter which roots contain, has gone for the formation of milk, muscle and bone, and does not come back to the soil in the manure, it will be found advisable to drill in with the seed a little guano or phosphate mixed with plaster. Two or three hundred pounds of this compound per acre will be found good economy, even when the land is otherwise well enriched. It gives the plants a good start, and a good beginning is usually followed by a good end.

Mangolds must be housed in this latitude by the middle of October, certainly before the frosts are so severe as to stiffen the earth. They will not endure the cold as well as turnips and carrots. A dry day should be selected for harvesting. They should be pulled in the morning; the leaves that have not already been fed can be easily wrenched off by the hand, which is better surgical practice than making an ugly wound with a knife; and in the afternoon of the same day they can be carefully stored in the root cellar. We say carefully, for they are too often handled as though they were stones—things without life. Every bruise that is made upon them breaks the cellular texture and increases the tendency to decay. We have learned to handle apples carefully. Most of us have yet to learn that roots are delicate in their structure, as well as fruit. We have seen them rapped violently together to knock off the loose dirt, and then the farmer complains that his roots do not keep well. The truth is the life was knocked out of them by the hard bumps. Mangolds do not mature before January. When first pulled they contain a peculiar acrid principle which is too relaxing for animals, but which entirely disappears in the course of two or three months. In January they are found to contain less pectine and starch and more sugar, a chemical action having taken place which converted these substances into sugar.

We have devoted so much time to the mangolds that we must pass over turnips and carrots hastily. The preparation of the ground for these roots is much the same as for beets. Turnips require a lighter soil, may be sown late in the season, and may remain in the ground till November. Of all the varieties of the turnip, the brassica campestris, originally brought from Sweden to England about a century since, stands at the head for feeding purposes, being harder than the brassica rapa, which is a native of England, possessing more nutritious properties, and retaining its juices and chemical composition unchanged till late in the spring. The Swedish turnip has a specific gravity of twenty to twenty-five per cent. more than the English turnip, and contains a much larger quantity, weight for weight, of sugar. It bears the vicissitudes of the weather and rough handling with great hardiness, and when bruised or bitten by cattle or mice, secretes a kind of temporary cuticle which keeps out the air and thus prevents decay.

Swedish turnips need no praise. We are willing to concede that, for feeding to most kinds of stock, they stand at the head of the roots; still we have not been so uniformly successful in raising them as we have been with beets and carrots. A small black beetle,—haltica nemorum,—attacks them in the seed-leaf, and if they escape this pest, they are inclined of late years to run up long-necked and with comparatively small bulbs. Possibly the difficulty is in the seed, but we took great pains, two years since, to get imported seed of the variety introduced by William Skirving of Liverpool, which has the sounding name of "King of the Swedes," but our success was no better than with seed of home production. We understand that in the eastern part of the State little if any such trouble is experienced, and what the difficulty is with us in the western part of the State we are not yet prepared to say. We are inclined, however, to attribute the defect to the careless mode of propagating seed, as some years they still do well with us. The turnip is a biennial, but shows a tendency in accelerating circumstances to complete its cycle of development in one year. This can be remedied in a measure by sowing late in the season, and by a careful selection of the roots from which seed are to be raised. The long, crane-necked bulbs must be entirely rejected from the seed-bed.

With the common English turnip we are as sure of a crop as we are of a crop of beets or carrots, and raise them abundantly with little labor, and find them excellent both for the table and for stock till about the first of March, when the sugar and starch begin to be converted into woody fibre. Our plan is to sow them in the latter part of July, on land from which early potatoes and peas have been taken, first plowing and top-dressing with compost, always preferring that in which there are night-soil and leached ashes. We sow the seed broadcast, and if just before a shower, do not care to brush it in, and have no further trouble with the crop except to harvest it in the latter part of October. We thus secure four or five hundred bushels of turnips to the acre, which are quite a supplement to the potatoes. The variety that we prefer for this speedy growth is the strap-leaved red top.

We also find it an excellent plan, to turn over after haying a piece of greensward, on which the grass needs renewing, and top-dress it in the same manner, and sow turnips in connection with grass seed. The land requires to be thoroughly harrowed, incorporating the manure with the soil, and rendering the whole mellow. When a rich and mellow bed for the seed is furnished, the turnips grow luxuriantly and seem to interfere but slightly with the growth of the grass, which the next summer turns out large swaths. This plan of sowing turnips and grass seed together in the latter part of July has the additional recommendation of enabling us to plow some low, moist land at this season, which we are unable to do in the spring, and renewing the grass without the intervention of a hoed crop.

One word for our friends the carrots. They have always stuck by us, and we will not desert them in this extremity of time. They are a healthy, nutritious crop, requiring tender nursing in their youth, but fully compensating for this in the rich milk they give the children, and the sleek, healthy coat they furnish the horses. The pectic acid they furnish seems peculiarly well adapted for the horse, and this noble animal should have a Sunday dinner at least of carrots, so long as he is fed on dry hay and grain. We prefer the long orange. We have sown them side by side with the famous white Belgian, and the yield of the orange is certainly larger, and we fancy it is a richer root, but of this we have never made or seen any accurate tests. The land for carrots should be either trench-plowed or subsoiled, that there may be no impediment to the downward course of its spindle root. It loves a deep, dry, rich sand loam, and is sure of amply rewarding the labors of him who sows in such a soil. The drills need not be over 18 inches apart, and the carrots should be two or three inches apart in the drills. Eight hundred bushels to the acre is a good yield, and 1000 can be raised. We can not recommend carrots as a substitute for grain for working horses. We only advise giving carrots as a complement to grain for such horses; but if any one has horses standing idle during the winter, hay and carrots are far more healthy than hay and grain, or hay alone.

In conclusion, we will say that whoever desires to be a radical farmer, to stir his soil from the foundations and raise the maximum of produce, which shall sustain the maximum of cattle that will give the maximum of manure, will raise roots. By no other mode of culture can New England be made to sustain so dense a population.

LECTURE ELEVENTH.

CHAPTER XXXIV.

FRUIT.

A SERIES of lectures on agriculture would not be complete, were the subject of fruits omitted. No farm is well equipped without its apple and pear orchard, and no farmer's garden should be without its sunny and sheltered nook for grapes, and its deep, well enriched, nicely cared for bed of strawberries. Fruit is not a mere condiment and luxury, only to be indulged in by the rich. The desire for it is implanted deeply in our natures, and God has given us no desire without some legitimate purpose and a corresponding object for its gratification. When we are surrounded daily by fruit and can partake of it when we please, we have no idea of the intensity of the craving for the high-flavored, refreshing, health-giving juices that fruit furnishes. We must leave the family orchard and the home cellar, and go into a strict boarding-school, if we would know the strength of our desire for fruit. We have seen boys at such a school pick up the cores of apples thrown away by the teachers, and devour them as choice morsels; and when we have found ragged urchins clubbing our trees, as soon as the fruit by its tinge of yellow showed signs of maturity, our indignation at the theft has been much tempered by our knowledge of the great temptation that the sight of the luscious apples must furnish the ill-fed and ignorant boys. It is the same temptation that led our Mother Eve to partake of the forbidden fruit, and resulted in the downfall of the race. From the days of Eden till now the children's teeth have ever been set with a keen edge for fruit. As we see our neighbor eating a beautiful peach, the saliva of our mouth spontaneously secretes for the digestion of a similar one. In tropical countries fruit is the main-stay of life, but in our cold climates, we need some more oleaginous and nitrogenous diet to keep us warm and furnish muscle for active exertion; but even here we require some fruit to keep our bodily functions in health. We would like an apple to eat each day in the year, and always feel better when we have one, and the pleasure is at least doubled when the apple is one of our own production.

This leads us to say that the delights incident to fruit culture always pay, even when the market furnishes no return in dollars and cents. Who, but the horticulturist, knows the pleasure there is in planting trees, observing their growth, and watching the expanding buds, the beautiful blossoms, and the swelling fruit? A peach from your own trees is worth half a dozen from New Jersey, not intrinsically, perhaps, but none the less really. It is priceless, not because money can not buy many such, but this is the product of your own culture, and you look upon it with a fatherly pride. Then the pleasure of sharing the products of the orchard or garden with our neighbors and friends, is one of the most exquisite we can enjoy. Few gifts are received with more grace than is fruit, and the pleasure of giving it is so great that we can hardly afford to sell it.

The orchard also makes home delightful. Some of the pleasantest associations of our childhood are with the apple orchard. The trees were all seedlings and the fruit none of the best, but we thought it was good, and this answered all purposes. Each child, as it came to years of discretion, was expected to pick out a tree as his or her peculiar property, and as we happened to be the eleventh child, we had rather poor picking; but as we shared each other's joys, so we shared each other's fruits, and fruit culture tolerates no jealousy. Here we made cider in the sunny days of August, long before the regular mill creaked and the press burst forth with the sweet juice, by making an excavation in the lime rock which served both for grinding and pressing. When the autumn days came, and the apples were to be housed, or carried to mill, we were busy as so many squirrels, and gathering the fruit seemed to us but play. We were not very particular about picking the fruit, and when we consider the shakings and whippings the poor trees received, we wonder they condescended to bear any more. The long poles striking among the branches must have made sad havoc among the tender buds, but, without malice or complaint, they bore the next year just as well, and we do not remember a year of scarcity.

The curculio, the bark-louse, and the borer, troubled us not. If they were in existence, we lived in blessed ignorance of them.

Then came the ride to the cider-mill, perched high on a load of apples and barrels; and the long draughts of sweet must through rye straws. We never stopped to consider what a villainous compound it might be of rotten apples and worm juice. It was sweet, and therefore must be good. The paring-bees, also, can never be forgotten, when we all assembled around the kitchen fire, and one used the paring-machine while the rest of us quartered, cored, strung and hung the apples around the room for drying. We might extend this picture further, and tell of the mug of cider and the dish of apples that were brought up from the cellar of a winter's evening as a neighbor called in for a friendly chat, but as cider is a tabooed article, now-a-days, we'll draw a veil over this social scene. We have said enough to show that the orchard adds vastly to the home pleasures, and whatever contributes to make a pleasant home is worthy of the attention of the farmer.

There is more beauty and poetry about farm life than some have imagined. It is not all utilitarian, as too many are inclined to make it.

> "There's beauty all around our paths if but our watchful eyes
> Can trace it, mid familiar things and through their lowly guise."

And there is no occupation which brings us in contact with so many of the beauties of nature as does that of the farmer. He treads carelessly every vernal day on flowers, the sight and fragrance of which would put the city lady in raptures. What sight more beautiful than that of an apple orchard in full bloom? Nature, in her luxuriant providence for producing fruit after its kind, furnishes ten and sometimes a hundred fold more blossoms than are requisite for maturing the fruit, and hence an apple-tree in the blossoming season is a magnificent bouquet of flowers. If the sight were not so common, it would fill us with admiration and delight. We lately saw a beautiful painting of a cluster of apple blossoms, which elicited the admiration of a country lady, and evoked the question, "What beautiful flowers are those?" When told, she replied, "Is it possible? Are they nothing but apple blossoms?" If she had been told that they were the flowers of an exotic plant from western Asia, called by botanists pyrus malus, her admiration instead of subsiding would probably have increased, and she might have ordered a plant from some greenhouse to adorn her parterre. The poetry of farm life lies mainly in horticulture, and we would like to see our farmers turning their attention more in this direction. It was in a garden, and surrounded by fruits, that our first parents lived while in a state of innocence. These were paradisian days, and if we wish to have paradise restored, we must give more attention to horticulture.

But we do not advocate the culture of fruit merely because fruit is healthy, and a pleasant thing to have and give away, and adds additional charms to home and life. If we stopped here we should expect the utilitarian to say, "This is all true, but I can't live on health, beauty and pleasure. I must raise something that will pay my taxes." The question of profit is a legitimate one, and deserves candid consideration, and we will answer it, Yankee fashion, by asking another. By what crop can we raise so much money value from an acre of land as by strawberries, apples, pears; and, where the soil and climate favor, by grapes and peaches? It is to be regretted that our census returns are not sufficiently distinct and accurate for us to ascertain the relative value of the productions of our orchards and gardens, as compared with our common field crops, but the records kept and reported by individuals leave no room for doubt on this point. Many of our strawberry cultivators announce their gross receipts from an acre as varying from $1,000 to $1,200.

A neighbor of ours, who is too infirm to perform the arduous labors of the farm, turned his attention a few years since to the cultivation of strawberries, and reports that he has raised some years, at the rate of 3,600 quarts per acre, and that his selling price, as he retails them himself, has never been less than 25 cents per quart, and sometimes is 40 cents. This gives, calling the mean price 30 cents, $1,080 per acre, a return which the tobacco producers have never equaled, though tobacco is considered par excellence the money crop. Some of the grape growers report a return of $3,000 per acre, and the pear growers run up into still higher figures. A thousand bushels of apples, worth at least $1,000, have been reported as the product of an acre.

These, it may be said, are isolated and extreme cases, and this is granted; but still they prove what returns fruit may be made to give, under skillful management and in favored localities, and what man has done man may do. Take a more common case. A neighbor of ours, who manages a large farm, and gives comparatively little attention to his orchard, using it for most of the season as a pig pasture (by the way, one of the most economical and successful modes of cultivating an orchard), assures us that he realizes a net income from his apples equivalent to the interest of $2,000 per acre. This is not bad interest for an acre of land to pay. Corn can not do as well as this, and tobacco can seldom do better.

We have watched with some interest the returns of a young apple orchard of 300 trees, which we set out some 16 years since. For most of the time we have kept the orchard in grass, mowing it twice in each season, which we were enabled to do by a liberal annual top-dressing. For the last six or eight years we have thus been enabled from this land to secure four crops annually: first, a growth of trees; second, two crops of grass; third, a crop of apples, which last year amounted to a thousand bushels. We do not know where the investment of $1,000 would yield a better return than in an acre of such land, stocked with apple-trees.

The little town of Marlboro, on the Hudson River, has for the last 25 years given its attention to the cultivation of Antwerp raspberries for the New York market, for which its slaty, dry soil is peculiarly well adapted; and from the monthly report of the Commissioner of Agriculture for January, 1869, we learn that the gross receipts of this town from this fruit alone are annually $300,000, and that an acre of Antwerps, in full bearing, is valued at $1,000; and that, since the introduction of the culture of raspberries into Marlboro, the price of real estate has advanced at least one-half.

Fruit-growers will be encouraged to know that, by the United States census of 1860, the value of orchard products in the whole country was in that year nearly $20,000,000, of which New York produced nearly three and three-quarter millions. Massachusetts, in 1865, a very dry and unfavorable year for the production of apples, returned by the state census a production of $1,257,477 worth of this fruit. The value of the pears raised in this state the same year was $240,338. In the production of apples, Middlesex is the banner county, furnishing one-fourth of the valuation of the whole state. In the number of pear-trees, Middlesex also takes the lead, but in the cash value of the fruit Norfolk stands at the head.

It has been feared by some that the great increase of orchards would glut the market with fruit, but the increased supply has not kept up with the increased demand. Some of the small and quickly perishing fruits may occasionally be found in the market in excess. In this case the remedy is to can them, and canned strawberries, blackberries and peaches are not bad to take in January. In the case of apples and pears, whose natural life is longer, a comparison of the prices for the last fifty years will show a constant increase in their value, notwithstanding the great multiplication of orchards. We well remember the time when the highest price paid for the best of the seedling apples was 25 cents per bushel, and 30 to 40 cents per bushel for grafted fruit was considered a high price.

Cider, in our boyhood, was sold at from fifty cents to a dollar per barrel, and the cider manufacturer was not particular if the barrel held forty gallons. We have lived to see cider sold by the gallon for as much as a whole barrel cost forty years since, and the refuse cider apples now command nearly twice as much as the best grafted fruit was once valued at. Two causes can be assigned for this enhanced and enhancing value of fruit. First, the great increase of fruit-consuming population; and second, the increased facilities for reaching market. Though fruit is one of the leading staples of our farm, we have no jealousy of our neighbor who plants an orchard. The more orchards we have around us, the better are we pleased, for the purchaser from New York or Boston, who comes to see our neighbor's fruit, will also have an opportunity to see and purchase ours.

The past summer was an unusually good season for apples in Massachusetts, but we never knew the market more brisk. We sold 1000 bushels directly from the orchard, and could have sold 1000 bushels more without leaving our own premises.

It is barely possible that apples may be produced in such quantities in the next fifty years as to overstock the market, but the history of the past fifty years does not warrant any fear of such a result. We more fear that the supply will not keep pace with the demand. It takes from ten to fifteen years to bring an apple orchard into good bearing condition, and this seems a slow turning of the penny to most farmers, and deters them from planting trees. They seem to have a fear that they shall not live to realize the results, and forget if they do not live, their children will. Such a selfish view is unworthy of the Christian. A heathen poet, before the advent of Christ, said, "Graft the tender shoot; thy children's children shall enjoy the fruit." We wish such narrow-minded farmers could be imbued with more of the spirit of Sir Walter Scott, who, when setting out a tree in his old age, was reminded that he might not live to eat its fruit, and replied: "Were I to die to-morrow, I would plant a tree to-day." By planting fruit trees we are only paying to posterity the debt we owe our fathers.

The increase in the market value of pears is greater than in the case of apples. Two dollars per bushel for Virgalieu, the choicest pear of our childhood, was considered an extravagant price. Whoever now buys a Beurre d' Anjou or a Duchess d' Angouleme has to balance the weight of the pear with nickel, and all the choicest varieties taste so strong of silver, that a prudent man thinks twice before he purchases. Though pear-trees bear at an earlier age than apples, and are less subject to the attacks of insects and disease, still the demand is far ahead of the supply, and is likely to be for a long time to come.

CHAPTER XXXV.

THE APPLE.

THE subject of fruit is too extensive to be embraced in one lecture, which is all the space we have for it, and we will therefore confine our remarks to the apple, which is the standard fruit of New England, and in the cultivation of which we have had the most experience. The word apple is of Celtic origin, and is derived from abhal, meaning a round fruit. The Celtic root is ball, meaning simply a round body, so that our modern word apple originally included pears, peaches, oranges and all round fruits. It is doubtless in this generic sense the word is used by the translators of the Bible, and we are by no means sure whether it was an apple, or a peach, or an orange, that tempted Eve in the garden of Eden, and comforted Solomon among the hills of Judea.

The modern cultivated apple, the pyrus malus, had its home in southern Europe and western Asia, where from time immemorial it has been found growing wild under the common name of crab apple. The American crab, pyrus coronaria, though improved somewhat by cultivation, has never been much elevated from its inferior normal state. The Siberian crab, pyrus baccata, shows more tendency to sport and has a wide range of latitude in which it grows, being found as far north as Lake Baikal, where it grows three or four feet high, with a trunk three or four inches in diameter, and producing fruit of the size of peas.

In Oregon is found a native crab, pyrus rivularis, much resembling the Siberian in its habits, which grows to the hight sometimes of 25 feet, and produces a pleasant, sub-acid fruit of the size of a cherry. Very early in the history of horticulture, the pyrus malus attracted attention by its tendency to sport and its capability of improvement under cultivation, and at the present day no fruit is so generally diffused over the earth, yields so bountifully, keeps so well, is adapted to so many purposes, and is so generally and highly valued.

In New England, where the climate forbids the cultivation, except under glass, of the semi-tropical fruits, the apple must ever constitute the leading object of attention with the horticulturist. This is the less to be regretted as by cultivating suitable varieties we can have apples fit for the dessert of a king, from the beginning to the end of the year. The juice of the refuse apples furnishes a beverage which, when properly manufactured, is little if any inferior in aroma to that made from the grape, and in healthfulness we are inclined to think far superior. In cooking, no fruit can compare with the apple. For the dessert we may prefer a melting pear, a luscious peach, or an aromatic grape, but for puddings, pies, tarts and jellies, the apple is indispensable.

We must make the most of this leading fruit, this good gift which Providence has assigned us, and we are confident that nowhere in the wide world does the apple attain a higher flavor than in the strong soil of some of the sunny slopes of New England. The western apples are generally larger and fairer than those of the Eastern States, but they do not possess so high a flavor nor make so good pies and cider. When our fathers first came to New England they brought with them apple seeds to start their nurseries and orchards, but very little attention was paid for many years to the grafting of choice varieties. They were too much occupied with the cares of church and state, and securing a livelihood for their families, to devote much time to the niceties of horticulture, and the consequence was that not one seedling in ten produced good fruit, and not one in a hundred proved first-rate.

Grafting is, however, not a modern art. It was practiced long before the Christian era, and the grafting of olives and grapes is alluded to in the New Testament. Pliny mentions 29 kinds of apples that were grown in Italy in his day, and says, "Our list of apples will immortalize the names of their first grafters,—such as Manlius, Certius and Claudius."

Appius first grafted the quince on the apple stock, and the quinces thus grown were called Appiana. Both Pliny and Virgil speak of the trees of their time being grafted with all manner of fruits and nuts, and the boys in our high schools are inclined to smile at Virgil's poetic license, when he speaks of the same tree producing fruits, nuts and berries, as we have been educated in the belief that there is a limited range of affinity between the scion and stock, but some of the French horticulturists have reproduced, by what they call charlatan grafting, these phenomena of the old Romans.

Cæsar, in his conquest of Gaul and Britain, doubtless carried to these countries, among other Roman blessings, that of good fruit; but if he did, the blessing was pretty much banished from England upon the conquest of that country by the Saxons, and was not restored till the fifteenth century.

Pippins were first introduced into England in the reign of Henry VIII. The Ribston Pippin, which the Englishman esteems the best apple grown on the island, originated in Ribston Park, Yorkshire, from the seeds of an apple brought from France. In 1597, John Gerard, in his History of Plants, mentions seven kinds of pippins, and thus exhorts his countrymen to plant orchards: "Gentlemen that have land, plant, graft and nourish trees in every corner of your ground; the labor is small, the commodity is great; yourselves shall have plenty, the poor shall have somewhat to relieve their necessity, and God shall reward your good mind and diligence."

Our fathers brought over from England and the continent a few of the grafted trees of the old country, but they have never done as well in America as the native seedlings. The Ribston Pippin, which ranks among the other apples of Great Britain as the bills of the bank of England among those of other banks, is not considered a superior fruit here, and the Spanish Reinette, which is the national apple of Spain, and to which we are indebted for the parentage of our Fall pippin, falls far below its native American descendant.

Although we have not given that attention in this country to the cultivation of new varieties, which the importance of the subject demands, and most of our best apples are chance seedlings; still, so favorable are our climate and soil for the production of this fruit, that American apples command in European markets double the price of those of native growth, and our Newtown Pippins, Esopus Spitzenbergs, Rhode Island Greenings, Massachusetts Baldwins, and Northern Spys, not to mention a host of others, are sure of finding sale abroad, if our home market ever becomes overstocked.

The apple is peculiarly a plant of culture, and susceptible of great improvement, and among the pleasures of horticulture there is none greater than that of producing new and choice varieties. In the wild state, every genus of trees has a number of species. Thus, we have a number of varieties of elm, and each variety in its natural state exactly reproduces itself. But with our cultivated trees, especially those designed for the production of fruit, the case is very different. These all show a culture which removes them from a state of nature, just as man himself is removed from a state of barbarism. Civilization does for the fruits what it does for humanity,—refines, purifies, elevates.

With this higher civilization, it must be confessed, come less physical strength, a greater variety of diseases, and more tendency to decay, both among men and the fruits.

When once a variety of fruit has been removed from a natural into a cultured state, we have the means of continuing the improvement indefinitely, for the fixed original habit being broken up, the new variety always shows a tendency to sport, or produce other varieties still farther removed from the original species. The seeds of our common wild cherry trees will invariably produce wild cherry trees of the same sort; but the seeds of the Black Tartarian will sport, and the trees produced from them will perchance be of one sort and perchance of another; and while the tendency is constantly backward to the natural, wild state, one seed out of a hundred may possibly produce a tree that will bear fruit superior to its parent. There are so many blanks in comparison with the prizes in this lottery, that most cultivators prefer to avail themselves of the experiments of others, and propagate from buds and scions of well-established and approved varieties. Few have the means, patience and skill of Van Mons to sow seeds, year after year, carefully rear the trees, and find, after a life of devotion to the production of new varieties, only now and then one worthy of propagation. Van Mons began by sowing the seeds from a young seedling without much regard to its quality, provided it was in a state of variation and not a wild sort. Selecting from the young plants the most promising, he watched for their fruit, and was not discouraged by finding them of an inferior quality. The seeds of the best he sowed, and found the next generation coming more quickly into bearing and the fruit of a higher grade. In the fifth generation, he found pears fruiting in three years from the seed, and the fruit quite uniformly good,—so that the old couplet,

> He that plants pears
> Plants for his heirs,

is not true now-a-days. Apples, Van Mons found, were improved in less time than pears, four generations sufficing for the perfection of this fruit.

It must be remembered that what the fruit gains, by this artificial culture, in size, flavor and tenderness, the tree is apt to lose in constitutional vigor. The thorns disappear, and the whole tree puts on the look of refined civilization; so that, in fruit-growing, regard must be had to the constitution of the tree, as well as the delicacy of the fruit. Van Mons started with the theory that we must subdue the vigor of the wild native in order to produce the best fruits, and to this end he cut off the taproots of the trees he transplanted, and placed them in close contiguity in his orchard. To sow, resow, sow again and sow perpetually, he considered the great secret of improving fruit. In a state of nature, hardiness of the plant and the perfection of the seed seem to be the objects aimed at; but, in a state of culture, we desire early maturity and enlargement and refinement of the pulpy portion of the fruit, and it is possible, in the case of grapes and apples, to carry this refining culture so far that a well-developed fleshy pulp may be formed without any seeds being inclosed.

Hybridization is a more expeditious mode of improving fruit than the sowing and resowing of seeds, as practiced by Van Mons. This is a modern art. Bacon, with his close observation of nature, seems to have had an idea of it when he says: "The compounding or mixing of plants is not found out; which, nevertheless, if it be possible, is more at command than that of living creatures, for so you may have a great variety of new fruits and flowers. Grafting has not the power to make a new kind, for the scion ever overruleth the stock." This power of improving varieties by crossing has been very successfully practiced by Mr. Knight, president of the London horticultural society, and is largely resorted to by gardeners of the present day, more especially in multiplying the varieties of flowers. The great number of beautiful roses, fuchsias, verbenas and other flowering plants owe their origin to careful cross-breeding. The process is so well understood that it needs only to be alluded to.

Mr. Knight also advocated the theory that all varieties of fruit had, like the individual, a certain limitation of existence, and would, after a time, run out, the period of their existence varying with the natural age of the tree from which they are derived. This theory has many facts and analogies to support it, and has been quite generally received among intelligent fruit-growers. The old Roman apples, which Pliny thought would immortalize the names of their originators, are no longer known, and Mr. Knight says: "The Redstreak and the Golden Pippin of England can no longer be cultivated with advantage. The fruit, like the parent tree, is affected by the debilitated old age of the variety."

We know that in this country the Virgalieu pear can be no longer grown in New England, and that certain varieties of potatoes have become so diseased as to be unworthy of cultivation, and that some species of animals have become extinct. But, notwithstanding these facts, we see no reason for concluding that the life of a variety of apples, or of any fruit, must be limited to the natural life of the tree from which it was derived, or by any other limit of time. Some of the varieties of apples which were considered run out in England, have renewed their youth in this country. The Virgalieu pear still lives and flourishes in the Middle and Western States. Some varieties of potatoes have become diseased, and possibly extinct, because we have cultivated them so artificially, and in such contravention of the laws of vegetable physiology. The fact that the varieties of fruits and vegetables, which are considered obsolete in one portion of the country, still flourish in another portion, proves an uncongeniality of soil, or climate, or mode of culture, rather than a decay of the variety from old age. We can see no reason why the life of a tree may not be renewed from its buds, as well as from its seeds, which are merely the buds perfected. The buds are annual, and contain germs of future trees, as well as the seeds, and if the tree can be reproduced without limit from its seeds, as both Scripture and fact warrant us in believing, why may not the buds have equal potency in perpetuating the species?

We are sorry to differ from so skillful pomologists as

Knight of England and Kenrick of this country, but we are more sorry to believe that any of our old favorite varieties of fruit must die of old age; nor do we believe facts warrant the conclusion to which these eminent fruit culturists have come. The autumn Bergamot pear, which is believed to be the same variety that was cultivated by the Romans in the days of Julius Cæsar, nearly 2000 years ago, still grows with vigor, and bears abundant crops of healthy fruit, while the Flemish Beauty and others of the modern pears, propagated with the sacrifice of constitutional vigor, show as unmistakable signs of decay as does the Virgalieu. This early decay of varieties propagated in Van Mons' enfeebling method, the lamented Downing prophesied would occur, and the fact verifies his close observation, and, we venture to prophesy a short career to the Rose potato, if its propagation is continued by successive sprouts from the same eye or bud. No eye was ever designed to furnish more than one sprout, and to give this one a good start in the world, it needs the aid of the parent tuber or trunk.

The character of fruit is, like the character of man, of the utmost importance, and nothing can compensate for its loss; but unless it is accompanied and strengthened by a good constitution, it amounts to but little. The hardiness of any variety of apple depends much upon the circumstances of its origin. When a new variety springs accidentally from a healthy seed, in a natural manner, as fortunately most of our American apples have, we may expect great constitutional vigor; and when hybrids are produced artificially in Mr. Knight's method, regard should be had, not only to the character of the fruit, but the vigor of the trees. Though we do not believe varieties will ever die, when properly propagated from buds, and properly cultivated, still we have great faith in nature's common mode of propagation by seeds, and we have found the chance seedlings, growing wild by the side of fences, making good healthy stocks on which to graft. The fact that the seed has germinated and the tree has grown in these unfavorable circumstances, shows inherent vigor, a determination to push its own way through the world, while many of the nursery trees, grafted on small pieces of roots, are delicate in their constitution, and when transplanted suffer in the change from hot-bed culture into that of the open field.

CHAPTER XXXVI.

PROPER SITE FOR AN ORCHARD.

THIS leads us to say that, upon the selection of a site and the preparation of the soil for an orchard, much of the success of fruit-culture depends. In general it may be said that orchards should be well exposed to the sun, and at the same time protected from blighting frosts and winds. We prefer an elevated site, sloping to the south or east, where the sun may rejoice the apples in the morning, and give them high flavor and color. The sun is the great source of life and beauty on this earth, and plants welcome the morning light after their night's repose, just as men do, and delight in being on the sunny side of a hill, as ladies delight in living in the sunny side of the house, and the cheek of the one receives its beauty from the sun equally with the cheek of the other. There is as much difference in the flavor of the two sides of an apple as in their color, and a benevolent husband, as he pares an apple, will always give his wife the sunny and high-flavored side, and we will add, for the benefit of such husbands, that the eye end of the apple contains more elaborated and refined juices than the stem end.

One of the worst sites for an orchard is a narrow valley in a mountainous country, with a brook running through it, or springs oozing from the adjacent hills. In such a valley the frosts linger the latest in the spring, and make their first appearance in the autumn, and even in the middle of summer the nights are too damp and chilly for healthy vegetation. No matter if such a valley is thousands of feet above tide water, if it is surrounded by high hills, especially if abounding with springs, the cold air will settle in it of a still night and prove fatal to fruit. No wise man would build his house and bring up his children in such a damp, cold location, and apples love light and warmth just as much as the children do. It is not a bad rule to locate your orchard where you would your house, on some elevated, sunny-sheltered site.

The contiguity of large bodies of water to an orchard is desirable, as the water in this case tends to produce an equilibrium of temperature, as large masses of water do not become suddenly cool or warm. A low, level island may, from this cause, furnish an excellent site for an orchard, as the modifying influence of the water materially changes the climate. One of the best locations for fruit culture in the United States is found on the ridge extending along the south side of our great western lakes. The soil must have some credit for the excellence of the apples of western New York, northern Ohio and peninsular Michigan; but if Rochester soil were transported into one of our cold, damp, uneven-tempered valleys, it would not produce such Northern Spies as it now does.

Some shelter from the prevailing winds is always desirable for an orchard, and where it is not found in some neighboring forest or hill, may be furnished artificially by planting a belt of evergreen and deciduous trees to the windward. We know that some contend that the winds give tone and strength to the tree by swaying the limbs and increasing the circulation of sap; and that some of the healthiest and most symmetrical forest and fruit trees are found in open and exposed situations. We do not object to good ventilation in our orchards, any more than in our houses; but as we like to temper the air a little before it comes in contact with our bodies, so we should prefer that a chilling blast should pass through a pine-tree before it struck the orchard. The little spindle leaves of the pine were made purposely to withstand an encounter with Boreas, and when the keen edge of his fury has been dulled by the pine, the damage he can do the orchard is comparatively small, and still his strength will be sufficient to give the trees all the shaking they may require. When an apple-tree is in bloom, or heavily laden with fruit, the more gently it is handled by the wind the better we like it.

The preparation of the soil is scarcely less important than the selection of a site for an orchard. The apple-tree is, indeed, a cosmopolite, living everywhere and doing the best he can under the circumstances in which he is situated. In the granite soils of central Massachusetts, in the alluvial meadows of the Connecticut, in the sands of Cape Cod and the clays of Berkshire, or wherever he may be placed, he endeavors to make the best of his situation, and to accomplish the mission for which he was sent into the world. We have seen a little stunted apple-tree upon a mountain pasture, browsed upon by the cattle and buffeted by the winds, but still maintaining its ground for many years, armed with thorns and looking as fierce and plucky as a hedgehog, and almost as invulnerable as the rocks by which it was surrounded. Such determination to live and bear fruit deserved a better fortune. Though the apple may live in almost all soils and situations, it does not follow that he has not his favorite homes where proper food and shelter are furnished, and where he thrives most.

There is much soil in Massachusetts where it would be perfect folly to plant an apple-tree without some previous preparation, and very little, if any, soil which may not be improved so as to render it fit for apple culture, so far as food for the tree and fruit is concerned; and as an orchard is a permanent investment, which we expect to continue long after we have ourselves mouldered into dust, it is worth while to look well to its foundations, just as we are careful about the foundations of our houses.

Both the chemical constituents and the mechanical structure of the soil must be regarded, if we wish our investment in an orchard to pay us an hundred per cent, and it is not easy for after-culture to compensate for want of previous preparation. An apple-tree loves a strong, dry, deep soil, abounding with calcareous and other mineral elements, and having a porous subsoil. If the mineral elements are wanting, they can be most economically supplied by means of wood ashes, lime and bones. It is not necessary, in the case of trees, that the bones should be ground or even crushed, as we wish them to furnish food for long years, and this they will do by slow decomposition if plowed in whole. We have found horn-piths to answer a good purpose in an orchard, and these we have bought at the tannery for a dollar per load. If excessive moisture abounds, it must be drawn off by thorough drainage. If the soil is too clayey and compact, it must be pulverized by the plow and made more porous, either by muck, sand or barn-yard manure. Heavy, unleavened bread is no more uncongenial to man than stiff, wet clay is to an apple-tree; and as the unleavened dough can be aerated and made most wholesome, so can a clay soil be made porous, permeable to the air, and well adapted to the production of apples; not because clay is direct food for vegetation, but because its particles are extremely comminuted, and have power to absorb from the air, that great reservoir of nutrition, those elements which plants mainly live upon. The trees may not come into bearing in a clay loam so quickly as in a sandy one, but we are satisfied they are more healthy, more productive, and probably will endure longer; as the general rule is, that whatever matures and bears fruit most speedily, also perishes quickly. In all cases we should recommend a deep plowing of the soil, with a trench or subsoil attachment to the plow, and the cultivation of some hoed crops for a year or two previous to the planting of an orchard. It is desirable, also, that the plow should be kept running for two or three years after the orchard is set, and the ground kept well aerated; but after this length of time we have found the plow too rough a surgical instrument among the roots, and we have preferred to stock down to grass, and trust to an annual top-dressing to keep the land mellow. This, we know, is not according to the rule of horticulturists generally, but we have found the trees on the grass land to do better in the long run than where the plow was used for a longer time.

Neither should we advise plowing an old orchard. The severe root-pruning the trees receive by plowing, aided by the decomposition of the rotted sod and possibly by a coating of manure, may make them bear bountifully for a year or two, but it is like the evanescent flickering of a lamp before it goes out. A reaction is very apt to follow, and the orchard decays rapidly. A better mode is to top-dress the orchard every year, and we shall find remuneration in the health and fruitfulness of the trees, and the abundant crops of grass. It is folly to suppose that land can support large trees yielding large crops of apples, without fresh supplies of raw material to work up into wood, leaves and fruit. If the soil is strong it may do this for a few years, but exhaustion must follow sooner or later; and in most of our orchards, if a large crop of apples is secured one year, the trees must lie fallow the next in order to recuperate, to extract from the air and the soil material from which fruit can be manufactured the succeeding season. If, however, the land is top-dressed annually, it produces fruit as regularly every year as a cotton mill turns out its annual supply of goods. At least such has been our experience. The supply of fruit is not equally good every year, and occasionally a tree fails altogether, but we see no evidence of a year of plenty followed by a year of famine.

Apples failed very generally in Massachusetts in 1865–6–7, and many feared the crop would never prove good again, but it must be remembered that the summers of 1864–5–6 were unusually dry, and apples suffer much more from drouth than pears, as their roots do not extend into the soil so deeply. But during these seasons of drouth those orchards suffered least where the soil was deep. The roots of some varieties of apples are inclined to penetrate the soil more deeply than others, and those varieties whose roots run most perpendicularly suffered least from the drouth. As a general rule, it will be found that when the branches run up nearly perpendicularly the roots extend downward rather than longitudinally, provided the character of the sub-soil is such as to allow of such extension. Thus during the severe drouths of the past few years, the Early Strawberry, the Cheeseboro Russet, and the Northern Spy bore very good crops on our grounds, while the Greening, whose roots and branches extend more longitudinally, blossomed profusely enough, but the fruit fell off in July. The summer of 1867 was wet enough for fruit, but the drouths of the three previous summers had so far impaired the constitution of the trees that it took them one year to recuperate. During the drouth of 1866 the leaves curled and many of them withered and fell from the trees, so that the elaboration of the sap was imperfect; and in 1867 there was not vitality enough in the trees to produce fruit that year, though moisture was plenty; but the trees grew finely, the leaves assumed their dark green again, healthy fruit-buds were formed, and in 1868 we had a bountiful harvest of apples. If the loss of our apple crops in the last few years can be attributed mainly to the severe drouths, as we feel confident it should be, then it follows that the deeper and more finely pulverized we can make the soils for our orchards, the less they will suffer from the dry seasons.

But we must hasten to say a word in favor of the more careful planting of the trees. More than a third of the little whip-stalks which we buy from the nurseries fail of bearing fruit for the want of proper care in transplanting, and proper nursing in their infancy. We dig a little hole in the sod, in which we tuck the roots in a cramped position and cover them with sods, poor earth and stones, and bid them adieu, which means we commend them to Providence. If they live in such unfavorable circumstances, it is the result of God's providence and not of man's sagacity. Many of the saplings,—some say one-half, but we will call it a third,—die of sheer carelessness and neglect before attaining to treehood, whereas not one tree in a hundred should die if properly selected, transplanted and

AYRSHIRE COW, OWNED BY WILLIAM BIRNIE, ESQ., SPRINGFIELD, MASS.

nursed. Much skill can be exercised in the selection in the nursery. We want healthy trees to start with, those of stocky growth, smooth bark, and we greatly prefer those budded near the roots to those that are root-grafted. In digging the young trees they must be handled as things of life, and not as mere inanimate matter. As many roots and rootlets must be preserved as possible, and kept from exposure to sun and air. The nurserymen no doubt intend to be careful, but their hirelings cut and bruise the roots shockingly, and we have been more vexed with the paucity and poor condition of the roots of trees ordered from nurseries, than from almost any other thing in horticulture. How to plant we can not so well say as in the language of Bryant:—

> "Wide let its hollow bed be made:
> There gently lay the roots, and there
> Sift the dark mould with kindly care
> And press it o'er them tenderly,
> As round the sleeping infant's feet
> We softly fold the cradle sheet."

We have found it an excellent plan to place at the bottom of the "hollow bed" some bones, covering them with mellow earth, and on this place the tree. In after years the roots can be found thickly interlaced among those bones, slowly decomposing them, and appropriating their elements for the support of the tree and its fruit. With such care exercised in transplanting, we will guarantee the trees to live, at the usual commission of 2 1-2 per cent.

Neither must the trees be neglected after the "dark mould has been sifted and pressed over them tenderly." The turtle may lay her eggs in the sand and desert them, trusting to the warmth of the sun to hatch them, but perpetual vigilance is the price of success with the orchardist.

No sooner is a tree planted than its insect enemies find it out, and commence their depredations. The borer and the bark louse, prey upon the body of the tree, the caterpillar upon the leaves, and the curculio on the fruit. As a remedy for the borer and bark louse, we have found nothing so effectual as soft soap diluted with water in the case of young trees, and used pure when the bark has become thick. We put it on with an old broom, and the trees look as much better for the washing, as does the face of a dirty urchin.

For killing the lice, we prefer to use the soap the latter part of May, as the young brood makes its appearance at this time, as does also the beetle which lays the eggs for the borer. Another brood of lice is hatched about the first of August, and another dose of soap may be necessary at this time, if any stragglers failed to receive their portion of the first application. Oily mackerel brine is perhaps equally efficacious in destroying the lice, but the soap cleanses the bark more effectually, and enables it to co-operate with the leaves in performing their function of respiration. The bark lice are small and apparently inert and insignificant insects, but they are little vampires, multiplying rapidly,—as under each scale may be found 30 to 40 eggs—and they suck the life-blood of the tree unless exterminated.

The curculio is a more sly enemy. This is a small, brown beetle, as sluggish as the Turk, whose crescent it impresses upon the apple, and at the same time as sly as an Indian, keeping as quietly on the shady side of the fruit as an Indian on the shady side of the tree. It is much to be regretted that so little has been done to prevent the ravages of this insect. It formerly confined its depredations pretty much to the plum, but of late years the cherry, pear and apple show in their deformed appearance unmistakable evidence of the wounds this insect causes. It makes a crescent-shaped puncture through the skin of the apple, in which it deposits an egg which soon hatches into a worm that makes its way to the core of the fruit and causes it to fall. For some reason many of the eggs fail of hatching, in which case the apple has a knotted surface. Many devices have been suggested for bagging this little rogue, but none of them are likely to be adopted by common farmers. The saying is, "Every dog must have his day," and we live in hopes the principle will prove true in regard to the curculio. It is encouraging that in the summer of 1868, comparatively few crescents were discovered upon the apples of Massachusetts, which were unusually fair. There is no evil in this world without its corresponding antidote. Man's faculties would lie dormant were they not taxed to overcome the vicissitudes of life. An easy and universal remedy for the curculio has not yet been discovered. He will be a public benefactor who finds some mode of banishing the little Turk from his dominion over the apple orchard. The farmer would rejoice as much as the Russians would to see the sultan banished from Europe.

The pruning of an orchard requires some skill. We have quacks in pruning as well as in medicine. Not every M. D. can amputate the limb of a man successfully; nor is every professed pruner qualified to amputate the limbs of a tree. In general it may be said that we prune too much, as the leaves and branches of the tree naturally correspond with the number and size of the roots, and are necessary for the healthy exercise of all the functions of the plant; still we can not agree with those who say that nature will do her own pruning without the intervention of man. Nature, we grant, does prune most skillfully, as we see in our forest trees, when the lower limbs perish for the want of light, and are whipped off by the wind, and we find some specimens of majestic and beautiful trees which have never felt the touch of the knife or saw; but then we may see many others that would have been greatly benefited by the care of man. We should as soon think of leaving our children or our flocks and herds to the care of nature as our trees. Judicious pruning gives them a symmetrical form, and induces fruitfulness. We like to see an apple-tree with a low head and the lateral branches evenly distributed on the different sides, and curving upwards like the ribs of an inverted umbrella. This formation of the head must be attended to while the tree is young, and can be better performed by the knife than the saw, as the latter leaves a ragged wound. As a boy rightly trained in his youth needs little after-guidance, so a tree once well started needs little after-pruning, except to lop off the decaying branches and the interloping suckers. The little necessary pruning is best attended to in the latter part of May, when the sap is in the freest circulation, and the wound heals most quickly.

As to the varieties, every planter must observe those which flourish most in his own neighborhood, and on soils similar to his own, and select accordingly. He should also study the wants of his market. If the orchard is planted for family use, we need varieties that will ripen at different seasons; if for a distant and winter market, only a few varieties are required, and these should be selected with a reference to their productiveness and market value. For home use we always want a tender, juicy, high-flavored apple. The market always demands a large, good-looking one. In the western part of this State we prefer for summer the Early Harvest, Red Astrachan and the Sweet Bough. (Williams' Favorite, we are ashamed to say, we have never cultivated.) For autumn, the Fall Pearmain, the Porter, the Gravenstein, the Fameuse, and the Fall Pippin. For winter, the Rhode Island Greening for yearly productiveness, late keeping, dessert and cooking qualities takes the lead in Western Massachusetts and New York, though in the eastern part of this State we are told it does not maintain its former reputation.

Taking the State throughout, the Baldwin probably stands at the head of the market apples ; but we think its beauty rather than its flavor gives it this pre-eminence, and its tendency to bear only in alternate years is a great objection to it. For high flavor and for cooking, we know no apple equal to the Spitzenberg, but its pulp is rather tough, and the tree has not the constitutional vigor which we so much desire. The Northern Spy promises to do exceedingly well in New England. It comes slowly into bearing, but when it has once commenced yielding fruit the product is abundant and of a crispy, high-flavored, and late-keeping quality. We shall be much obliged if any one will tell us how to grow this variety with more uniform size. The King of Tompkins County is another promising variety. It is a showy market fruit, originating in Tompkins County, N. Y., and the grafted fruit so far does well in Massachusetts. Whether the budded trees will be adapted to our soil and climate, we have not had sufficient experience to decide with certainty.

The Hubbardston Nonesuch is a Massachusetts seedling, and one of the best of our early winter apples. The tree is vigorous, an early bearer and great producer, and the fruit handsome and of first quality, though some object to it as wanting in positive acidity. This very mild, sub-acid flavor is to others a great recommendation, and we predict for this variety a greater reputation in the market than it has heretofore maintained. The list of good winter apples is so great that we can not pay our respects to them all, but we must not omit the Tolman Sweet, a native of Rhode Island, which is so excessive in its productiveness that it is much inclined to overtax itself one year and lie idle the next. The children call this a good dessert variety, but we prefer to see it baked before it is brought upon the table. The tree yields so bountifully that we have known one of fifteen summers' growth to furnish fifteen bushels of fruit.

We are conscious that we have not done this subject justice. We have not said half what we desired and intended to say upon the topics just touched upon. The orchard was the first love of our youth, and every tree planted has served to endear us to the home of our childhood. We can not better conclude than in the language of Gerard: "Gentlemen that own land, plant trees in every corner of it; the labor is small, the commodity is great."

LECTURE TWELFTH.

CHAPTER XXXVII.

CATTLE HUSBANDRY.

WE have considered some of the modes of improving the land and some of the crops raised on the farm, and now comes the great question with most farmers, "How shall we most profitably dispose of these crops? Shall we sell them directly, or shall we feed them to stock and sell the beef, butter, cheese and other products which this stock furnishes?" If it is decided to feed the vegetable products of the soil and convert them into animal products, the questions recur, "What stock is preferable, and what is the best mode of feeding?"

These questions and others incidental to them are of the utmost importance, as on the decision of them the success of the agriculturist must mainly depend. That in the great majority of cases the vegetable products of the farm must be converted into animal before they are sold, is the united testimony of history and of all observing farmers. In no other way can the farm be kept in good heart. There may be a few exceptions to this general principle. Some farms may be located so near cities and villages, in which fertilizers can be easily obtained, and the market value of hay, grain and roots is high, where it may be good economy to sell these products, but these exceptions do not controvert the general rule.

It may be difficult sometimes to cipher out the profits of keeping stock. If a valuation is made in the autumn of farm products, and the stock, and of the same stock in the spring after it has consumed all the products, it does seem sometimes as though the latter had been half wasted. It takes two tons of hay in Massachusetts to winter a cow, and when the hay is worth $30 to $40, the cow is often enhanced in value by her winter's feed only $15 or $20. There is an apparent loss here of half the value of the hay. The loss is apparent, not real. We must ever make a distinction between intrinsic and commercial values.

The intrinsic value of a cow in the spring may be fifty per cent. more than in the fall while the commercial value may be increased only twenty-five per cent. The commercial value can not be predicted with certainty. It often varies greatly in the course of six months, sometimes rising unaccountably high, and at other times suffering as unaccountable depression. Besides, in comparing the different values of stock in the autumn and spring, we seldom make sufficient allowance for the incidental profits,—the milk furnished, the work performed, and especially the manure cellared.

When hay was very high during the late rebellion, we advised a neighbor, a shrewd Irish widow, to sell her cow in the fall and buy again in the spring, and thus avoid purchasing her winter's stock of hay. Her reply was, "But where shall I get milk for the children, and where shall I get my potatoes next summer? The children live on the cow during the winter, and we all shall live next summer on the potatoes raised from the manure." Her mode of putting the questions and affirmations was irresistible, and we have no doubt she was right in persisting to keep her cow.

The fact is patent to every one, that where large herds of cattle are kept there is thrift. The land is well tilled and the purse well filled. From the days of the patriarchs, who kept large flocks and herds, till this nineteenth century, history abundantly proves that cattle husbandry has been and is the most successful branch of farming. The grain grower unconsciously, perhaps, to himself, makes inroads on his capital. By selling his grain he is slowly but surely impoverishing his land.

We knew a Massachusetts farmer who moved to the Genesee valley when that valley was in the height of its glory as the wheat producing region of the United States. He was so delighted with the golden harvest and its speedy returns in cash, that he wrote back to his benighted friends at the East, as New England was then called when Rochester was in the West, commiserating them on the slow turning of the penny which the raising of stock required, and saying that he should keep no more stock than was necessary for tilling his land and furnishing his family with milk, and boasting that he could raise wheat at a profit for five shillings (sixty-two and one-half cents) per bushel.

Little barn room and little fencing were required. Everything went swimmingly for a few years. The Genesee land was deep and fertile, but was exhausted after a time. The father died poor and the son, by resorting to cattle husbandry on the same farm, soon paid off the mortgage on the estate. By raising cattle, the penny is turned more slowly but more surely.

It takes three or four years to change the calf into a cow or an ox, but the calf grows while we sleep, and ere we are aware the little stiff-legged, awkward quadruped, worth only a few dollars, becomes a graceful heifer or steer that can be readily exchanged for a hundred dollar greenback. In the meantime the keeping has cost the farmer little expense that he feels, as the produce consumed is the result of his labor, and has never been entered on his cash account. When a pair of oxen is sold, the comparatively large amount received is regarded as the consummation of years of patient waiting, and is generally securely invested; whereas, if this sum had come in little driblets, it would probably have been expended as pin money.

Still the great secret of the general success of cattle husbandry is the enrichment of the soil. While the calf is being converted into the ox, he returns to the land a great share of the products consumed, and robs it of only the small amount requisite to form his carcass. The keeping of cattle always stimulates the husbandman to an improved agriculture. We never knew a farmer with forty or fifty head of cattle, who did not feel anxious to raise as much produce as possible on which to winter them, so that the great physical law of action and reaction holds good in cattle husbandry; the produce acts upon the stock and the stock reacts upon the produce. The more cattle the more manure, and the more manure the more produce, and the more produce the more cattle. Thus the forces of nature are correlated.

Not one of the least advantages of stock-breeding is the increased stimulus it gives to the mental faculties of the farmer. Almost any one can raise hay. It grows spontaneously and needs comparatively little human skill to direct in its management. Just so with all vegetation. There is science involved in the laws of vegetable growth and we wish there was more skill exercised in the cultivation of all vegetable products, but the animal economy is one degree higher than the vegetable, and to understand this economy calls for the exercise of higher mental powers.

Comparatively few persons have the keen, practiced eye and the sensitive touch nicely to discern even the external points of a good animal, and fewer still understand the laws of breeding, and of animal physiology and pathology. To manage with the greatest success a large or even a small herd of cattle, requires a knowledge of their anatomy, the functions of the different parts of the body, the food best adapted to develop muscles, bones, fat or milk, and the diseases to which animals are liable and the remedy for the same. Very few farmers study these subjects as they should; still the owner of a choice herd feels the value of such knowledge, and every day leads him to the exercise of more or less practical judgment on these points and no mental faculty is ever brought into healthy exercise without being strengthened.

Cattle husbandry not only exercises and invigorates the mental faculties, but it also quickens and cherishes the affections, and thus adds vastly to the pleasures of life. There is great pleasure in aiding and directing vegetation; in making ten blades of grass grow where one grew before; in tending the flower garden and watching the development of the leaves and flowers; in planting trees and observing the expanding buds, the opening blossoms and the golden fruit; but there is a higher pleasure still in guiding animal life. The rose and the peach are things of life and beauty, and give us exquisite enjoyment, but they do not appreciate our care and attention, and never sympathize with humanity. Not so with the animal. In his eye we see the higher beauty of intelligence, and though he can not say "Thank you," in response for our kind attentions, still he looks grateful. There was much truth in the remark of a poor man, who when asked to sell his pet dog for a valuable consideration replied, "No, I can't part with him. I would like the money, but the wag of the dog's tail when I come home tired at night is worth more than money." There is a sympathy between a kind master and his dumb beast which gives a higher pleasure than that which merely ministers to the gratification of the senses. It stirs the soul. Next to divinity and humanity, the lower animals call forth our affections and excite pleasurable emotions. Indeed, we have known cases where the beast seemed to be held in higher estimation than humanity. We have seen the children going barefooted, ragged, unkempt, and untrained, while the colt was carefully shod, groomed, blanketed, fed and tutored. So strong does the love of that intelligent animal, the horse, become with some men, that with them the horse is first, and the wife and children are second. This is a sad perversion of the affections, a substitution of an inferior for a higher good. Much as we delight in tending the dumb beasts, in ministering to their wants, guiding their development, and noticing their endeavors to reciprocate the kindness, still we have no sympathy with that morbid affection which is often lavished upon a poodle dog, which should be bestowed upon a child that has a higher intellectual and moral nature.

The value and importance of cattle husbandry can only be learned from the statistics of the government. In a former lecture we have given the returns of the cattle of Massachusetts in 1865, and we have no census of the United States since 1860. In that year the neat cattle of the whole country, including the territories, were: Cows 8,728,862, working oxen 2,240,675, other cattle, including all under three years old, 14,671,400, total, 25,640,937; calling the cows $40 each, the oxen $50, and the young stock $25, the total valuation was $827,973,230. The increase, both in number and price, in the last twenty years, especially in the western and south-western states, is immense. From 1850 to 1860, the number of cows increased in Illinois from 294,671 to 532,731, and in Texas, which promises to be the banner state for cattle and sheep husbandry, the increase of cows within the period named was from 217,811 to 598,086, nearly a triplicate ratio in ten years.

During the war there was great slaughter of neat stock in those states over which the hostile armies ranged; still, it is calculated that in the country at large, the increase from 1860 to 1870 will be fully equal to that of the previous decade. We are, in fact, just beginning to comprehend the vast resources of our country for cattle production. The increase in this state of the valuation of horses, oxen and cows from 1855 to 1865 was $4,731,269, and this in a state whose natural productions have been said to be only granite and ice. Great as is this increase, there is a large margin for further improvement.

The statistics give us no means of ascertaining how many acres are required, on an average, to support a cow in Massachusetts. We wish they did, that the farmers might be shamed into a more thorough cultivation of their land. We speak within bounds, when we say that the average number of acres each cow requires for her support through the year, is six. Others have estimated it as high as ten. Allowing that a cow requires two tons of hay for her wintering, we know that it must require over two acres on an average for her winter support, as the average production of hay is less than one ton per acre, and we allow twice this amount, or four acres, for the summer pasture. This is probably below the real fact, but, even with this low estimate, this is three times as much land as is necessary to sustain a cow when she is fed nothing but grass and hay.

Custom authorizes the main reliance by the farmer on the grasses, green and dried, for the support of his cattle during the entire year; but does not our increasing population, bringing, as it does, an increased demand for beef, milk and dairy products, require that we should adopt other articles for feeding stock, that will yield a greater amount of nutritious food to the acre than do the grasses?

We have, in a former lecture, suggested and advocated the roots as one of the means of increasing and improving our herds, and we desire here to mention one or two others. The Stowell evergreen corn makes a fodder superior to hay for milch cows, and the amount that can be grown on an acre is fourfold. We have never weighed this fodder when thoroughly dried, but in its green state we could hardly believe the steelyards; and we shall not tell you what they told us, for fear you will call our veracity in question; but others estimate the yield of the evergreen sweet-corn when dry, at ten tons per acre. It is so succulent that it is difficult to cure it perfectly for safe storage, and we have therefore preferred to use it green, and depend upon the rowen crop of hay for the main food of our cows during winter.

Another fodder for our cattle which we desire to suggest, is cabbages. The cabbage is one of the most nutritious of vegetables, and approximates the nearest to meat as food for man of all the vegetables commonly placed on our tables. Indeed, no vegetable product is so rich in nitrogen, mushrooms alone excepted. The dried leaf of the cabbage, according to Johnston's analysis, contains from thirty to thirty-five per cent. of gluten, the muscle-forming compound. The Irishman, therefore, in following the instincts of his nature, and choosing cabbage for his diet, chooses as well as science could choose for him. We are confident the value of cabbages as food for stock has not been sufficiently appreciated. We have raised them for years, mainly for market, feeding only the refuse leaves and small heads to the cattle, and find that on no green food do they thrive more, and this is the testimony of all who have tried them.

Mr. Birnie of Springfield is probably the most extensive feeder of cabbages of any one in the state, as he cultivates several acres purposely for feeding cows. His testimony is: "I have found no green food that will put flesh on cows like cabbages." The amount of this food that can be raised on an acre varies with the strength of the soil. There is scarcely any limit to it. On good, rich land, (and cabbages can be raised on no other,) twenty to twenty-five tons per acre is the ordinary yield, and the labor required in their cultivation is but a trifle more than in cultivating an acre of corn. That they are an exhaustive crop we can not deny; but what the land loses the cattle gain, and the more rapidly we can convert the inert matter of the soil into beef and milk the better. We have no such fear of exhaustive crops as some express, unless they exhaust the land, as does tobacco, merely to stimulate the nerves of men.

If cabbages will convert more soil into beef in one year than any other vegetable, then we shall vote for cabbages, just as we should choose machinery that would most rapidly transform cotton into cloth. More cotton may be exhausted, but more cloth is made, and this is what we are driving at, and the sooner we reach the goal the better. Show us a crop that does not exhaust the land, and we will show you one that furnishes comparatively little nutriment. The cabbage, however, being a broad leaved plant, derives much of the nourishment, which it furnishes to cattle, from the air, and whatever we can appropriate from this great reservoir of plant food, this common stock which all are at liberty to draw upon indefinitely, we consider as so much clear gain.

CHAPTER XXXVIII.

FEEDING OF STOCK.

THE manner in which stock is fed is scarcely less important than the material of the food. In feeding ourselves, we are very particular that the food should be properly prepared, brought into a fine state, and cooked and seasoned to a nice point. In the preparation of human food, there may be some question whether we have not carried this point to its extreme limit, and tickled our palates at the expense of our stomachs; but no such question can arise with respect to the food of our cattle. The custom has been to feed them the raw products uncut, unground, uncooked.

Now, we can see no reason why a cow may not prefer to have her hay, roots and grain cut, ground and cooked, as well as man to have his food properly prepared for assimilation. Our Andersonville prisoners found it tough living to grind the corn with their teeth, or even to convert corn meal into palatable food. Our cattle are not over-nice in their tastes, but there is good reason for preparing their food so that it may be acceptable and easily digested. Some argue that, as there is no more nourishment in food when cooked than before, cooking is a waste of time and fuel. But why do we cook our own food? It is not merely to make it more palatable, but also that it may the more readily and thoroughly be assimilated.

Much vital energy of man would be wasted in eating whole kernels of corn or wheat; and then the nutrition would not be so thoroughly extracted from the grain, as it is when the flour is first fermented and baked.

The fermentation, which is the first step towards decay, aids the animal just so far that it anticipates this process, which would otherwise have to be performed in the stomach. This view is confirmed by the practice of the best feeders. We visited, a few days since, the large herd of Jerseys belonging to Mr. Adams of Watertown. The hay, meal and roots fed to this stock are all steamed before being fed, and it is estimated that the cows give twenty to twenty-five per cent. more milk than they would from the uncooked feed. Even the water is made tepid before the cows are allowed to drink it, so that the animal heat may not be reduced by drinking cold water. A large dairy farmer in Berkshire, who is a close observer, and who endeavors to make each cow do her best, and who, in 1868, did make his herd return him an average of $100 per head, says he is satisfied that he can make 25 per cent. more milk from cooked food. The testimony of Mr. Birnie, who supplies milk to the city of Springfield, and of Mr. Collins, who furnishes milk to the village of Collinsville, is to the same effect. The increased flow of milk we do not attribute entirely to the fact of the food being cooked, but also to its being much diluted with water; for milk, having 80 per cent. of water in its composition, necessarily requires a large amount of this fluid, a principle which those who object to feeding roots because they contain 80 to 90 per cent. water will do well to consider.

Cooking food for cattle costs something, we grant, and whether it may not be more economical to let the animal do his own grinding and cooking at the expense of some of his vital energy and the waste of some nutrition, each farmer must judge for himself. A boiler, sufficient to steam food for a large herd of seventy-five to one hundred cattle, costs from $100 to $125, and a steaming box is a simple affair which any mechanical farmer can make for himself. In case only a small herd is kept, and steaming is deemed unadvisable, corn and other grains may be soaked in water till they become soft and begin to ferment, when they will be found more palatable and nourishing to stock and the miller's tolls be saved.

Regularity in feeding is essential to the highest success in cattle husbandry. In a well regulated family there are stated times for meals, and the household are expected to be present at these times, and not eat helter-skelter, as chance may furnish or appetite demand. When the habit of regularity is once acquired, our natures conform to it and we seldom feel hungry except at the appointed seasons for meals, no matter whether the dinner hour is at twelve, two, or four o'clock. Show us a family where the children eat at all hours, and make a dining-room of the buttery, and we can generally show you a lot of pale-faced, dyspeptic children. Regularity and system are no less important in the herd than in the family.

Cattle that are fed irregularly are uneasy, constantly on the *qui vive* for something to eat, while those that are fed systematically, do not start with every opening of the barn door, but wait quietly till the customary feeding-time comes.

A supply of pure water is the next requisite to a supply of good food. The old practice of driving cattle once or twice a day to a neighboring brook or spring, is more honored in the breach than the observance. It is wasteful of manure, muscle and health. Man never thinks of eating without drinking, although most of the food he eats is largely diluted with water, lean beef containing 75 per cent. When deprived of both food and drink for a season, his first and great want is water. Where cattle have convenient access to water, it is curious to notice how many times in a day they will drink. When compelled to go without drinking twelve or twenty-four hours, and fed on dry hay, they must suffer greatly.

One of the largest and best breeders of Durhams in Massachusetts, and indeed in the whole country, Mr. George T. Plunkett of Hinsdale, has a trough of water constantly before his cattle in the stable, with a little trap door which the cattle soon learn to raise when they wish to drink. He feeds four times each day, and assures us that his cattle invariably drink after each meal. Cows can not furnish milk without an abundance of liquid food. To compel them to manufacture it from dry hay and one or two drinks of cold water per day is unreasonable. If they comply with our demand they must do it at the expense of the tissues of their bodies, look "spring" poor when turned out to grass, and be worth only half as much through the summer.

The impression is quite general among dairy farmers that milk can not be made with profit in the winter, and thus the cows are permitted to go dry three or four months. This is too much like a manufacturer shutting up his mill during the dry months of summer. To secure the greatest returns from a cow, the milk must flow pretty much through the year, and those who are furnishing milk for the city market affirm that their greatest profits are in the winter, when the price of milk is nearly double what it is in the summer, and the flow little, if any, less.

To secure this even flow through the year the cows must be furnished with warm stables well littered and ventilated, and an abundance of succulent food. The secret of the success of the Berkshire farmer, whose cows returned him $100 per year in 1868, was in the fact that he fed them "slops," as he called it; that is, the meal, bran, and everything he fed was well watered. We have no idea his milk was as rich as though the cows had been fed with dry meal, but if milk can be watered by putting the water into the mouth of the cow, we know no law against it.

Pure air is more essential to the health of the animal than pure water, or even food itself. The animal takes food three times a day, but breathes continually. It can live without food some days, but can not live without air a moment. As we go into some stables the odor is enough to stagger one. Cattle may possibly live in such an atmosphere, but they can not thrive, and the milk must have a stable flavor, as it is a great absorbent of the gases of the air.

There is no necessity for such a suffocating atmosphere in the stable. One or more ventilators, simple box-tubes, a foot square, should run from the cellar to the barn roof with openings into them from the stable, and up these tubes will rush a constant current of air heated by the bodies of the animals and the fermenting manure. As much of the gases of the manure as possible should, however, be retained by some absorbent. For this purpose, plaster scattered daily around the stables is excellent, but we have found it no better absorbent than fine sand or loam.

We recently visited the herd of Ayrshires owned by Dr. Loring of Salem, some seventy in number, and found the stables all littered with sand, and the air having none of that offensive smell too common in most barns, though large deposits of manure were fermenting in the cellar beneath the stables. Loam is a still better absorbent than fine sand, but does not furnish so clean a bed for the cattle to lie upon. We formerly thought nothing but straw would make bedding for cattle, but we are satisfied they like sand just as well, and the sand keeps the air sweeter and makes excellent compost for clay or mucky soils. Straw in these modern days commands so high a price, that the use of sand is recommended as a matter of economy as well as an absorbent.

We can not pass over this subject of the care of animals, without alluding to the importance of treating them kindly. We can tell in a moment, as we go into a pasture with the owner of a herd, whether there is sympathy between him and his stock, or whether they are treated by him as a mass of inanimate clay. Some herds welcome their master as children do their father, crowd around him, and are gratified with a gentle tap from his hand. Other herds play shy of their owner, and seem to look upon him as an enemy. Animals appreciate gentle treatment, and always do better when they receive it. A man who has little sympathy with his dumb beasts, but kicks and scolds them, does not deserve to own any, and had better sell to the first neighbor who will treat them more gently. Every blow and every scare given to an animal detracts so much from its vital energy, and drives it from a domestic to a wild state.

The Irish woman who addresses her cow more gently than she does her brother, derives all the more benefit from the food she furnishes the animal. The cow can not express her gratitude for the gentle treatment in words, but she shows it on her ribs and in the milk-pail. We are pained every summer to see the village cows, with their udders overflowing with milk, driven home by careless boys with the speed of velocipedes, and pelted with stones as though they were as insensible as the rocks.

There is no natural antagonism between men and the lower animals as some suppose. In the garden of Eden they came to our first parent to receive their names, and Adam doubtless gave them a kind and welcome reception, and they manifested no terror nor malice. It was man's (not to say woman's) sin and cruelty that put enmity into his heart, not only to his Maker, but also to the lower orders of creation, and it is the same sin and cruelty in his posterity that continues the enmity. We have no patience with the man from whom, when he goes into his barn-yard, the cattle and the hens flee as they would from a bull-dog. Such cows never give so much milk, and such hens never lay so many eggs. To man was given the dominion over the beasts of the field, and the fowls of the air, but it was never intended that he should play the cruel tyrant. We rejoice in the organization of the society for the prevention of cruelty to animals. Rarey has taught us the true method of establishing our dominion over horses, and farmers will find it greatly to their pecuniary advantage to extend the same principles of decision, kindness and sympathy to cattle, and indeed to every living creature.

Of the adaptation of different kinds of food to different animals, in the different stages of their growth, and with a view to accomplish different results, we have spoken in former lectures, when treating of the different crops, and only allude to it now to say that this subject demands more careful attention from farmers than it has generally received. The animal is simply the farmer's machinery by which he manufactures his grass, grain and roots into beef, milk and their kindred products, and it is not only necessary that the machinery be good, but also that it be furnished with the proper kind and quantity of raw material from which to manufacture these products. We are satisfied that at least one-third, possibly one-half, of the value of our crops is wasted by injudicious feeding.

Too many feed their growing stock as though it were their purpose to convert it into beef at six months' sight, and the feed for muscle, milk, and fat is too uniformly alike. A good cow produces from two thousand to three thousand quarts of milk in a year, and whether the amount is one or the other of these figures depends much upon the quantity and quality of her food.

If the object of feeding is simply growth, building up the frame-work of the animal and covering it with muscle to give it locomotion and sufficient fat to lubricate the machinery, then milk is the food for the infantile period of growth, and grass, roots, and possibly a few oats for the latter stages of development. Milk is the natural food of the young animal, and nothing can supply its place. For the first week the calf should have pure, fresh milk to start the viscera and all the organs into healthy exercise; after that the milk may as well be skimmed, unless the object is to make veal (of which we must say, in passing, we make too much in this country). The cream subtracts little if any of the casein or muscle-forming qualities of the milk, and the calf develops just as well (if not better) upon skimmed milk.

We have heard objection made to skimmed milk upon the ground that it is not the natural food; in the wild state the calf has the pure article. Very true, but we must remember that our domestic animals live in an artificial state, and their habits are essentially modified by their changed mode of life. The amount of milk that a cow in her naturally wild state gives, is very small, and will not hurt the young animal, but to turn a calf with its dam upon a mountain pasture through the summer, as is the practice of some, makes a very fat, plump-looking calf in the fall, but the owner is generally disappointed in its after development. The young animal should, however, have a liberal allowance of the skimmed milk to keep it in good growing condition, and when turned into a small inclosure to get a bite of grass; it should also have a supply of pure water, for the calf is a great drinker. A little boiled oat-meal gruel will now do no damage. Corn or flax-seed meal will give a more rounded or sleek look to the calf, but the object in raising young stock is to make them grow, not to fatten them. For the winter feed, early cut or rowen hay and roots most promote healthy growth.

Where the object in feeding is to produce milk in quantity, without reference particularly to its quality, succulent food must be furnished in unstinted supply. The more water a cow can be made to take with her food, the more milk she will give. The milk produced from such food may look a little watered, and is watered, but it is done legitimately. Fresh, succulent grass is the most convenient and natural food of the milch cow in the grazing season, and she should not be compelled to wander far nor work hard in search of her food. No matter how active her disposition, the more easily she obtains her food and the more time she has for rest, the greater will be her flow of milk.

From the luxuriant and succulent grasses of June, the greatest amount of milk is obtained, and when the herbage of the pastures becomes dry and scanty, the flow of milk can be kept up by supplementing the grasses with red clover or sowed corn fodder. This mode of feeding is termed soiling, and is indispensable when a full supply of milk is required through the season. One acre of land, well cultivated in soiling crops, will yield as much nutrition for cows as four or five acres of common pasture.

We have found orchard grass, red clover, and sweet corn the best soiling crops, and we have named them in the order in which they come into use during the summer. Orchard grass starts early in the spring, and in a deep rich soil has a wonderful luxuriance of growth. We know no forage crop that will produce so great an amount to the acre, unless it is the Stowell evergreen corn; and the orchard grass has the advantage over the corn of coming earlier in the season, and yielding a succession of crops till late in the autumn. When cut the young blade shoots up immediately, and under favorable circumstances grows two or three inches in twenty-four hours. Red clover is highly relished by cattle as a soiling food, gives a great flow of rich milk, and yields two or three successive crops. Nothing, however, delights the milch cow so much as sweet corn, or gives more abundant supplies of good milk. It is just as easily raised as the common corn, and the Stowell variety yields almost as bountifully as the southern gourd-seed, continues in good feeding condition till frost comes, and cabbage leaves, root tops and pumpkins are ready to supply its place.

Soiling has long been practiced in England and Holland, and was first introduced into this country, or at least, first brought distinctly before the public, by the late Josiah Quincy; and we are confident that in the neighborhood of cities, and wherever land is high and the dairy is the leading branch of farming, it will be found the most profitable mode of summer feeding. Soiling does indeed require some extra labor, but labor is not a bugbear which farmers should be afraid of, and is amply compensated by the increased quantity of milk and manure, and the diminished amount of land and fencing required. Mr. E. W. Stewart of North Evans, N. Y., gives us in Mr. Allen's late work on American cattle, the results of three experiments in three different seasons, made to determine how long a certain number of animals could be kept on one-quarter of an acre from one cutting of clover. "In the first experiment, seven cows and four horses, equal to twelve cows, were fed fifteen days. In the second experiment six cows and five horses were fed fourteen days, and in the third, eleven cows were fed sixteen days. In each instance the feed was equal to keeping one cow from one hundred and sixty-eight to one hundred and eighty days, or nearly the usual pasturing season." Mr. Stewart's experience of ten years' soiling is that the cows give one-tenth more milk when soil-fed than when pastured, and that soiling has uniformly improved the health and condition of his animals.

We have dwelt thus largely on feeding with reference to the production of milk, because we fully believe that milk should receive increased attention from the farmers of Massachusetts. We can not compete with our western friends in producing grain, beef, pork and wool, but they can not furnish our Eastern cities and villages with milk, and few of them seem to know how to make good butter and cheese. Few persons realize the amount and value of the milk and cream consumed by the family.

We commonly think and speak of bread as the staff of life, but where milk and cream are as freely used as the health and comfort of the family demand, the milk bill will always be found larger than that of flour, and the same is true of the butter bill. Indeed, in most families, it will be found on examination that flour is the fifth item in the list of table expenses, beef, butter, sugar and milk taking the precedence, and three of these items it will be noticed are the products of cattle husbandry. Massachusetts butter and cheese have long been held in high estimation, and we are now successfully competing with Orange County,—a county, by the way, with no very definite boundaries, as it seems to extend along the Erie road wherever milk is furnished,—in supplying New York city with fresh milk.

The sweet pastures of the Berkshire hills furnish a milk which is conveyed one hundred and sixty miles, and commands in the New York market a higher price than the famous Orange County article. Possibly the farmers of the Housatonic valley have not learned all the tricks of the trade, and the high price obtained may be due to the purity of the article as well as the sweetness of the herbage. If so, time will determine. We trust the Berkshire farmers will maintain their integrity, and they can well afford to, for their united testimony is that the profits of furnishing milk are from twenty to forty per cent. more than by manufacturing it into butter and cheese by the domestic dairy.

The cheese factory is also giving a great stimulus to cattle husbandry in this state. The experience of the last few years abundantly proves that the cheese factory is capable of doing for the keeper of a herd of cows what the woolen factory has already done for the keeper of a flock of sheep. Cheese making is one of those divisions of labor that always accompany increased population and civilization. It is but reasonable to suppose that a man who gives all his mind to the manufacture of cheese can understand his business better than one whose mind is distracted with other pursuits, and the fact that factory cheese is more uniform in quality and commands a higher price than that of domestic dairies, is proof that this is the case.

If two or three persons, with the conveniences of a factory, can take care of the milk of five hundred cows better than ten times this number of persons can in the private dairy, by all means let us have the cheese factory, wherever there is not a demand for fresh milk. On this same principle of division of labor, we see no reason why we may not have butter factories, and indeed both butter and cheese can be manufactured in the same building. The oily matter in milk which goes to make butter is entirely distinct from the casein which furnishes the curd. We would not advocate the manufacture of white-oak cheeses, so tough and hard that they would answer for the wheels of ox-carts; but still true economy demands that from rich milk a part of the oil be extracted before the casein is separated from the whey. The latter may not be as good for fattening pork, but the cheese will suffer no loss of its muscle-forming power, the property which gives it so high value as an article of food. Certainly the gain in the butter will be greater than the loss in the cheese.

CHAPTER XXXIX.

BREEDS OF CATTLE.

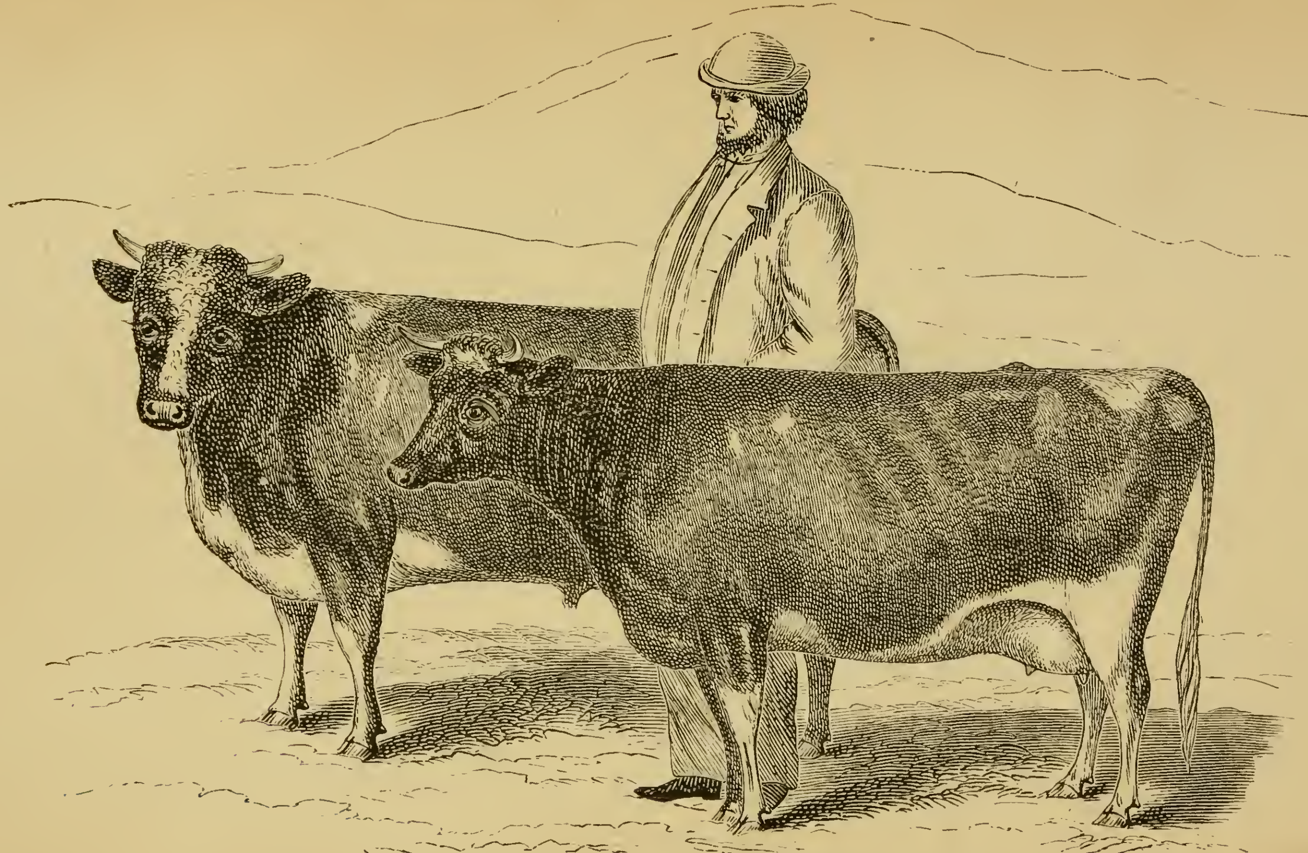
BUT we must hasten to speak briefly of the different breeds of cattle, with which we are as greatly blessed as was that most skillful breeder of old, the artful Jacob. In the first place, we have our native cattle, a conglomerate of all the breeds of western Europe. It has been generally supposed that the prevailing original breed of New England was Devon, as the Pilgrims came from Plymouth in Devonshire; but the first cattle imported into New England were landed at Boston, four years after the settlement of Plymouth, and very possibly the first stock may have come from Lincolnshire, where the coarser short horns abounded. It is safe to infer that the various emigrants to New England brought with them the cattle to which they had been accustomed, and those from the counties nearest the ports where they were shipped, and after they were imported were intermixed in all possible degrees. Their descendants, even now, give evidence of their origin, as we still find the favorite mahogany-colored Devons, the white-faced Herefords, the polled or hornless cows of Suffolk and Norfolk, and the black Galloways from Scotland, occasionally cropping out among our native cattle. Many of them are well formed, and are excellent, both as oxen and cows. Few of the thorough-breds will excel in quantity or quality of milk some of the native cows; but there is no certainty that the natives will transmit their good qualities to the next generation.

Besides the English breeds of cattle early imported into this country, the Danes, who had settled on the Piscataqua river in New Hampshire, brought over in 1631 some Danish cattle, large and coarse, of a yellow color. The Dutch, in 1625, imported into New York some of the black and white cattle of Holland, which spread up the Hudson river and into the western part of this state.

We thus have had in New England a great variety of crosses, and as the best of the different kinds have usually been selected for propagation, we have had and now have unusually good herds, but no effort has been made on an extensive scale in this country to originate any distinct breed. There has been less occasion for this, as the English have labored in this direction with great zeal, and we have reaped the fruit of their labors. There are in Great Britain now at least nineteen different breeds of cattle, and the number is constantly increasing. Thus the three little islands of Jersey, Guernsey and Alderney have, until recently, furnished a breed passing under the common name of Jersey or Alderney; but now these islands are as jealous of each other as three Bantam roosters, each claiming a breed peculiar to itself, and fearing contamination with the other, much as do the different castes of India. The French also have fifteen distinct breeds, and in a recent French work on cattle, engravings are given of fifty-five European varieties of the bos taurus. Great Britain, however, it is acknowledged on all hands, stands at the head of all the nations of the earth in the excellence of her neat cattle, and from her mainly have we derived the means for starting the thorough-bred races of this country.

The breed which has attracted the most attention, both in England and America, doubtless, is the Durham, which was first distinctly brought to the notice of the public by the brothers Charles and Robert Colling, in the latter part of the last century. The Short-horns have been bred in this country for the last fifty years, and we now have some herds which will compare favorably with any of which England can boast. For size, early maturity and beauty no cattle fill the eye like the Short-horns, and, when beef is the leading object with the farmer, they stand unrivaled. They were originally, also, noted as milkers; but so pleasing to the eye is the full, rotund carcass of the early-maturing Durhams, that breeders have been tempted to feed them high from early calfhood, so that the tendency has been to produce flesh rather than milk. This is especially the case in the western and south-western states, where beef is the prime object in cattle husbandry. Some of the Ohio and Kentucky Short-horns scarcely furnish milk enough to bring up their calves. In New England, where the dairy must ever be the leading object with the farmer, we must select those families of the Short-horns that have been bred with a reference to milk as well as good sirloins. Fortunately we have in Massachusetts, in the herds of the three leading breeders,—Mr. Plunkett of Hinsdale, Mr. White of Framingham and Mr. Lathrop of South Hadley,—Short-horns whose pedigrees are traced through long lines of good milkers.

It has been feared by some that the short feed of the hilly pastures of New England was not adapted to support the stately Durhams, but the fear has been dissipated by the results of practice. Mr. Plunkett's herd grazes on one of the mountain farms of Berkshire, and if any one can detect any deterioration in his stock he must



BRITTANIES, OWNED BY CHAS. L. FLINT, ESQ., BOSTON, MASS.

look with jaundiced eyes. The testimony of breeders is united that when the Short-horns and the native cattle are fed alike, both in the pasture and the stable, the Short-horn outstrips the native in growth and flesh. The difference of breeds can not originate in the feeding trough. There is something in the constitution of the animal, in its form and in its muscular and nervous organization which enables one to do better than another on the same feed, and this form and healthy action of the organs is perpetuated in the race.

We see the principle illustrated among men, as well as among the lower animals. Some are of the Cassius kind, lean and hungry, naturally nervous and excitable, and spend the strength which they derive from food in fretfulness and unnecessary anxiety. We know some men who are constitutionally so nervous or so deficient in some vital organ, that no amount of food can put much flesh on their bones. We should as soon think of educating a fool, as undertaking to put flesh on such a man.

Cattle have no stings of conscience, no fears of a panic in the money market, and no anxiety about the future; still, there is as much difference in their constitutional vigor and nervous organization "as among other folks," and the successful feeder must always have an eye to the constitution and temperament. The Short-horns have been bred with special reference to a vigorous constitution and a quiet temperament which enable them to digest and assimilate their food with great economy. Their short legs may not adapt them for the active motion of the Devons, but short legs, whether on bipeds or quadrupeds, are generally an indication of a tendency to put on flesh. To judge of the temperament, there is no feature so expressive either with man or beast, as the eye, and it is positively refreshing to notice the calm, cool dignity there is in the eye of a Short-horn. A school-master can not survey his pupils with more deliberation than a Durham manifests when he looks over his situation, and says, with his slow-rolling eye: "I am master here." We therefore accord to the milking families of the Durhams the first place on the list of the herds of cattle, in consideration of the two great purposes of cattle husbandry, milk and beef. Others we know differ from us, but the verdict of the country at large, as evinced by actual practice, sustains our opinion.

What breed of cattle we should raise must be determined very much by the circumstances of each individual. Where milk is furnished for market, there is no cow that pays better than the Ayrshire, which has long been distinguished in Scotland for her large flow of milk in proportion to her size and the quantity of food consumed, and a forty years' trial in this country has fully sustained her reputation. Mr. Birnie reports one of his Ayrshires as giving in five months, from pasture feed, green hay and corn-stalks, 5753 pounds of milk, or her own weight in milk for each of the five months, and 400 pounds over. It has been generally supposed that the Ayrshire milk is not as rich as that from some other breeds; still, the first Ayrshire cow, imported by the Massachusetts Agricultural Society in 1837, furnished milk from which was made sixteen pounds of butter a week for several weeks in succession, from grass feed alone.

For working oxen of medium size, no cattle can compare with the Devons. This is an old English breed, said to be contemporaneous with the conquest of the island by the Romans, and greatly improved within the last century. For the quantity of milk, the Devons are not remarkable, but its quality is superior; and for oxen we have never seen any that could equal them in fineness of bone, muscular power, intelligence, quickness of action and endurance. They are so docile, and at the same time so quick and active, that they can be trained to obey and endure like soldiers. If any one wishes to see military evolutions performed by Devon oxen, let him visit the annual fairs of some of the Worcester County agricultural societies.

For a family cow that will give good, rich coffee milk, we know nothing equal to the Jersey. This breed was introduced into the United States about thirty years ago, from the island of Jersey, where it has been bred for many years with particular reference to butter. The cow does not fill the eye, nor a large pail, but gives a milk rich in cream, and holds out through the year, and is becoming a great favorite, especially in the eastern part of this state. The Jerseys have improved in size and quantity of milk, both in their native home and in this country. One of the cows of this breed has been known to furnish three pounds of butter per day, five quarts of milk in some instances making a pound of butter. The Jerseys will never be hung for their beautiful forms, but they have fine heads and necks, soft skin and hair, the latter often fawn-colored, delicate limbs, good escutcheons, and with their owners are always great favorites, every Jersey breeder looking on his own herd very much as a crow is said to regard her own young. Indeed this is true of the breeders of all the different varieties of stock. The ladies especially make pets of the little Jerseys, and as Queen Victoria has a special fancy for this breed, gentlemen may as well make up their minds that the Jerseys will be the fashionable stock, and grant the ladies a right to the ownership of a beurre heifer.

A rival to the little Jersey has sprung up in the still smaller Breton cow, imported recently from France by our friend, the secretary of the Massachusetts Board of Agriculture. The average height of this cow is some thirty-eight inches, generally of black and white color, and with great symmetry of form. The Brittany cow is probably the progenitor of the Jersey, and like her descendant is distinguished for the richness of her milk and the long continuance of her milking powers. The nutty flavor of her butter is said to be superior to that of the Jersey, and in this respect she stands first among the breeds of France.

The Dutch cattle have been long famous for their milking qualities, and specimens of them were early imported into this country. They came from the low, moist, rich lands, extending from France to Holstein, where the soil and climate are exceedingly favorable to the production of grass and large races of cattle. They are great milkers, and the milk is particularly rich in casein.

Time fails me to speak of the other breeds, nor is it necessary. Every man must examine this matter of breeds for himself, be fully persuaded in his own mind, and judge what is best from his own stand-point. We are satisfied Massachusetts can carry twice if not thrice the amount of stock she now does, and it belongs to the farmers of the state to see that the capacity of our soil is fully developed, and that our thousand hills are alive with cattle.