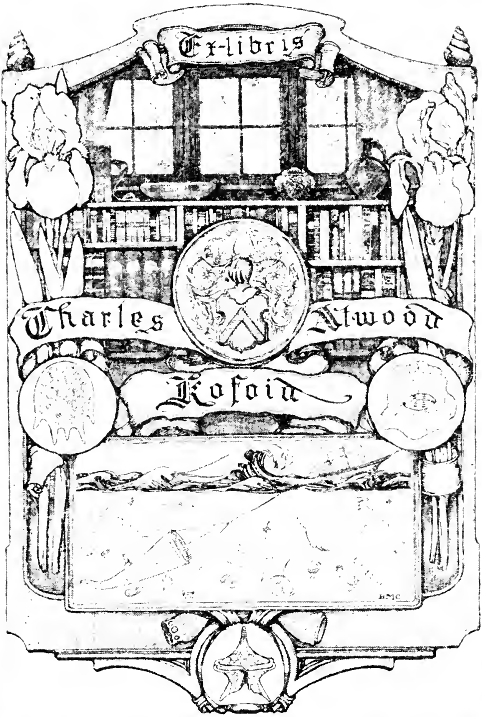
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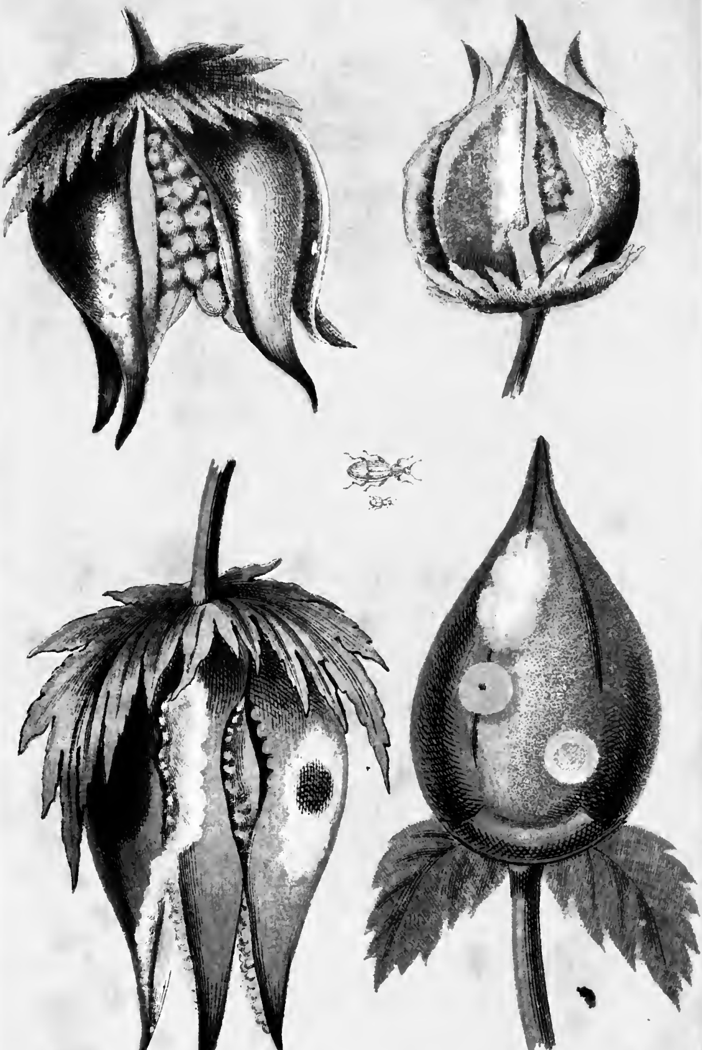


Rot in Cotton.

A Book for Every Cultivator of the Soil Adapted to the Great Staples.

WALL'S

Manual of Agriculture,

FOR THE

SOUTHERN UNITED STATES,

BY

MAJOR E. G. WALL, OF MISSISSIPPI,

PRACTICAL PLANTER,

Graduate of the Virginia Military Institute; late Civil Engineer and Superintendent on the Southside and the Mississippi Central Railroads; and during the late war, Major in the 18th Regiment of Virginia Volunteers, (Gen. Lee's) Army Northern Virginia.

MEMPHIS:
SOUTHWESTERN PUBLISHING COMPANY, 361 MAIN STREET.
1870.

TO THE READER.

The author, in submitting this MANUAL OF AGRICULTURE to the people of the Southern States, hopes to meet the almost universal desire for information upon the subject of which it treats. It is due to the public, that the author should distinctly state, that the facts, illustrations, experiments, and information herein contained, have been drawn from the most recent and reliable authorities, and from his own experience as a farmer. Credit is given in the introduction to the authorities quoted, and, also, to some extent, in the body of the book. Not being satisfied with the best written authority, the author submitted his manuscript to the inspection of Dr. E. W. HILGARD, Professor of Chemistry at the University of Mississippi, and late Geologist for the State of Mississippi, for revision and correction—with what result the accompanying letter testifies:

UNIVERSITY OF MISSISSIPPI, OXFORD, MISS., October 29, 1869.

MAJ. E. G. WALL:

Dear Sir—I have perused with much pleasure the manuscript of your FARMER'S MANUAL. Combining, as it does, *sound theory with correct practice*, it cannot fail to be eminently useful to the class for whom it is designated—the old-time planter, as well as the new-comer, who never saw cotton, tobacco, or sweet potatoes, grow. It is high time that all agriculturists should understand that they have as much need of "using their brains," as you express it, as the carpenter, the mason, or any other artisan; indeed, from the more varied nature of the materials they work, the necessity for a full understanding of the object of each agricultural operation, and the exercise of a discriminating judgment, is even greater, if they would not be left behind in the race of progress. I trust your little book will go far towards opening the eyes of the candid opponents of "Book Farming" amongst us to the fact that scientific agriculture consists, not in the *indiscriminate practice of Utopian notions*, but in working according to the best lights afforded by the *combined experience of past ages*. And so I wish the forthcoming volume God speed!

Very respectfully yours,

EUG. W. HILGARD.

The author is not unmindful of the ordeal through which his work must pass, yet he confidently trusts its merits will, in consequence, the more fully appear, whilst its faults will prove such as rather to stimulate investigation, and thereby improve the general stock of knowledge upon the subject of which it treats.

Respectfully, etc.,

E. G. WALL, Mississippi.

PART I.

CHAPTER I.

THE REASONS WHY A WORK OF THIS KIND SHOULD BE READ.

The author of this MANUAL has endeavored to supply a want deeply felt by himself in his first experience as a farmer; and, as far as his knowledge now extends, this want still exists with many others. All those who are about to enter upon the ennobling pursuit of agriculture, and even those who have had long experience as farmers, will find, we are persuaded, embodied in the work, facts, experiments, and illustrations, well worthy of their most earnest consideration.

In the present condition of the Southern States, with labor fluctuating and uncertain, the high price of provisions, and the thousand and one difficulties which meet the farmer at every turn, renders it absolutely necessary that he should call into requisition all the aid which science, the arts, and the experience of others, can yield him.

The author is aware that it is common for the so-called "practical farmer" to sneer at and deride the "book farmer;" with what justice one or two examples will illustrate. Take, for instance, Dr. M. W. Philips, of Hinds county, Mississippi. We find, for thirty successive crops, made before the war, that he averaged *eight bales of cotton to the hand.*

His first crop, on freshly cleared land, was the least: six bales to the hand; his largest, thirteen bales to the hand. His average per acre, throughout the succession of years, was one bale to the acre of land planted. Dr. Philips was a "book farmer." Now, let us take another example: Mr. David Dickson, from near Sparta, Georgia. Mr. Dickson, on old cotton lands, by *pluck* and intelligence, has, since the war, made an average of two thousand three hundred pounds of seed cotton per acre. We say by *pluck*, because it requires courage for any man to change from the usual manner of making a crop, and to spend twelve dollars per acre for fertilizers to bring his land up to the point of making a bale and one-fourth to the acre. We say intelligence, for it requires *brains* in any man to so manure and work his lands as to bring about such results. He not only produced these crops, but left his land in a greatly improved condition for succeeding crops.

The question naturally presents itself to the mind of every intelligent farmer: By what means can my lands be made to produce such crops? We answer: By *pluck and brains;* courage to procure fertilizers, and intelligence to apply them. It requires no small degree of courage to face the ridicule of our neighbors, for if we should happen to fail in but one experiment, although we may have succeeded in twenty, we will be laughed at.

For the encouragement of all who wish to try experiments, we will tell how some of the greatest inventors and experimenters of the world have been laughed at and derided. Watt, the inventor of the steam engine, was thought to be deranged, and his friends wished to place him in a mad-house. This powerful agent, steam, in a little more than a half a century, is whirling people over the land at the rate of from twenty to fifty miles per hour. Steamships cross the Atlantic Ocean in eleven to thirteen days, when in former times it took a sail-vessel from six weeks to three months to make the passage from New York to Liverpool. Morse, the inventor of the magnetic telegraph, how was he treated? He appeared before the Congress of the United States with his models and plans; he informed that body of statesmen that by means of a magnetic battery, an insulated wire, and an instrument, he could send a message by electricity from Washington City to Baltimore in an instant of time. Congress gave him no encouragement; one of its sapient members said, "he wished to send a message to the *man in the moon*." In less than six months afterwards, messages were flying on the "wings of the lightning" to and from all our most important cities. Now, in about one-fourth of a century, the world itself is belted by this wonderful wire, and messages are sent from San Francisco, California, to London, England, a distance of six thousand miles, in two minutes. Then, why fear ridicule? You can say with Dr. Philips and Mr. Dickson, "he who wins can laugh."

To the mind of every intelligent farmer, it must occur that some change is necessary in our system of agriculture.

It is the object of this work to collect together and compile *facts*, experiments, and illustrations, in such a form that they can be applied practically, to the every day work of the farm. The time has arrived when it is cheaper and better to renovate old, and comparatively worn out lands, than to clear fresh lands. No country on the face of the wide earth begins to improve permanently in agriculture until that time has arrived. As long as fresh fields can be cleared, and wood land is cheap, the farmer will abandon his old lands rather than improve them; but now, when it costs more to clear one acre than improve it, we may confidently expect to see great improvement in farming.

Nothing pays the farmer a better per centage on the investment than *manure.* The best farmer is not he who cultivates the largest number of acres to the hand, but he who *raises* the *best* and *largest crops* upon a given number of acres. The soil is somewhat like the man or beast—work it without nourishment it dies, or becomes worthless. The subject of improving the soil is now engaging the most earnest attention of our best farmers, and wherever *manure* has been intelligently applied it has paid at least one hundred per cent. upon the investment.

The farm is a great laboratory, and all those changes in matter, which it is the farmer's chief business to produce, are of a chemical nature; hence the value of at least a limited knowledge of chemical laws. The farmer breaks up and pulverizes his soil with the plow, harrow, and hoe, for the same reason that the practical chemist powders his minerals with pestle and mortar—to expose the materials more perfectly to the *action* of *chemical agents.*

To determine the best method of improving the soil; to economize the natural sources of fertility; to test the purity and value of commercial manures, and beds of marl and muck; to mingle composts, and adapt them to special crops; to improve the quality of grain and fruit; and to rear and feed stock in the best manner, farmers require at least a degree of knowledge of *chemistry*. Nor can they, as a class, much longer afford to be without it; for it has always been found that the application of scientific principles to any branch of industry puts power into the hands of the intelligent, to drive *ignorance* from the field of competition.

As an illustration of the foregoing remarks, let us examine one of the investigations of Dr. Sprengel in reference to *rust* in *wheat*. The close and long continued researches of Dr. Sprengel led to the conclusion that an excess of iron-salts, and especially of the phosphate of iron, greatly favored the growth of red-rust on the leaves and stalks of wheat, and other cereals. A soil in the vicinity of Brunswick, that did not lack drainage, but *lime*, was remarkable for growing wheat and barley, always attacked, and generally blighted, by *rust*. A quantity of this soil was taken into a field generally free from this ruinous parasite, to form an artificial soil fifteen inches in depth. Wheat planted in *this soil* was badly *injured* by *rust*, while that grown all around it in the same field was free from the malady. Dr. Sprengel, by *careful analysis*, found a fraction over a half per cent. of the *phosphate of iron* in the soil, with only a trace of *lime* uncombined with silicic acid. As free lime will take phosphoric acid away from iron, and indirectly convert iron into the harmless peroxide, and at the same time produce a valuable fertilizer, the *phosphate of lime—liming was prescribed, and the cure was perfect.*

To decry such *investigations* by skillful chemists, is to defy the *laws* of nature, an occupation which finds too much favor with farmers, who do not make use of the *brains* God has given them.

As discoveries multiply, and information becomes diffused, those farmers who decline to inquire into the principles which govern their vocation, will have occasion to groan more deeply than ever over the unprofitableness of agriculture.

In all parts of the brief outline here given, the author will aim to be as *concise* as is consistent with clearness. Much that will be written is intended as merely suggestive. The leading design is to present the *great principles of science* which are clearly connected with agriculture; and to show how these principles are involved in the daily operations of the farm.

It is hoped that the farmer will find many things so presented to his mind as to inspire him with renewed ardor in his honorable profession, and at the same time enable him to pursue it with increased pleasure. No profession or business can ever give much mental satisfaction to the man engaged in it, unless he has, first, a clear view of the principles which form the basis of his operations; and secondly, a distinct understanding of the relation between these *principles* and *his own practice.*

The author, in writing and compiling this work, is greatly indebted to Dana's Muck Manual, Campbell's Agriculture, Waring's Elements of Agriculture, Norton's Chemistry, Youman's Chemistry, Rogers'

Chemistry, and various Agricultural Reports of the Patent Office.

The author hereby acknowledges his deep and lasting obligation to Dr. Eugene W. Hilgard, formerly Geologist of the State of Mississippi, and now Professor of Chemistry in the University of that State, at Oxford, for his kindness in revising the Chemical part of this work, and for the information and aid received from his able and interesting Report of the Geology and Agriculture of Mississippi, made in 1860.

The author also expresses his gratitude to Dr. Smith, the Analytical Chemist for the State of Mississippi, for his kindness in comparing the analyses of the plants contained in this work, with the analyses of the same plants as published in Professor Liebig's recent work on agriculture, and not yet translated into the English language.

Hoping to meet the almost universal demand for information on the subject of agriculture at the South, the author respectfully submits this book to the reading and thinking farmer, and to the public at large.

CHAPTER II.

SOURCES FROM WHICH PLANTS DERIVE THEIR NOURISHMENT.

It has been ascertained by analysis that plants are composed of two sets of elements: the "organic elements," which are volatile, and disappear during combustion; the "inorganic, or mineral elements," which remain after the burning of the plant, and constitute *ashes*. These two classes seem equally necessary to the healthy growth and full development of the plant. They *are* the *food* of the plant, as they are taken up by it while growing.

Plants do not get ALL *their food from the soil on which they grow*, as many suppose. The *soil* and the *air* both furnish nourishment to growing crops. Through its *roots* the plant is in constant contact with the soil, and through its *leaves* it is in contact with the *air*. The roots are so constructed as to be able to take up from the soil such food as is required from that source, whenever it is found there in proper condition. But all substances absorbed by the roots must be rendered *soluble*, as the organs can take up matter only in a liquid form.

The *mineral elements*, being non-volatile, are not found in the *air;* therefore, they must be derived from the *soil alone*. Besides these, the soil must have a sufficient quantity of water or acids to dissolve whatever is required by the plant. The soil also, generally, contains a considerable quantity of organic or vegetable matter. This vegetable matter, when well rotted, is called "HUMUS, or MOLD."

Whence do plants obtain their organic elements? These, as we will show hereafter, are chiefly four—carbon, hydrogen, oxygen, and nitrogen. The carbon of plants is derived chiefly (but not entirely) from carbonic acid. This gas is one of the constituents of the atmosphere, whether the air is collected on the top of the highest mountain or in the lowest valley. Plants have the *power* of *absorbing* carbonic acid gas through their *leaves*. When vegetable matter in the soil undergoes decay, this gas is freely generated, and, being absorbed by the water in the soil, is conveyed abundantly to the roots of growing plants. As rain decends through the air, it absorbs a considerable quantity of carbonic acid gas, and conveys it to the soil. Thus, we find both the atmosphere and the soil to contain carbonaceous food for plants. Whether the carbonic acid is absorbed by the roots or the leaves of the plant, it circulates through the plant in solution in the sap; and under the influence of *light* it is *decomposed*, the plant retaining the carbon and throwing off the *oxygen* through its *leaves*. This action goes on more rapidly under the direct rays of the sun.

Hydrogen and oxygen are supplied to plants in the form of water. All vegetable compounds contain hydrogen and oxygen in the same proportion as they unite in forming water. The *leaves* of plants can absorb water from the air; the roots always absorb it from the soil.

Nitrogen is not so abundant in plants as the other three organic elements; but it is no less important, and even essential, to their growth. Ammonia is, no doubt, the chief source from which plants get their nitrogen. Nitric acid, in the nitrates, and other nitrogen compounds, are doubtless sources from which this important element is often derived. Ammonia is the *great source* of nitrogen in the vegetable world. Hence the great value of Peruvian guano.

Ammonia is found both in the atmosphere and the soil. From the atmosphere it is carried down by the rain and snow. In the soil it is formed by the decay of such animal and vegetable compounds as contain nitrogen. It is absorbed and retained by the clay and humus or mold in the soil. Some plants are believed to absorb it through their *leaves*, from the air; but in most cases it enters through the roots from the soil.

Although nitrogen is so abundant as the chief constituent of the atmosphere, yet it rarely or never enters directly, in its pure gaseous form, into the plant. In contact with decaying vegetable matter in the soil, nitrogen, in the form of air, unites with hydrogen, *forming ammonia.* The ammonia formed in this way, as well as that formed by the decay of animal matters, are again decomposed by strong bases, such as lime, potash, soda, etc.; the nitrogen becoming oxydized, forms nitric acid (aquafortis), while the hydrogen combining with oxygon, becomes water.

The nitric acid, or aquafortis, generated as above, combines with whatever bases may be present in the soil, forming *nitrates.* Thus are formed the nitrate of potash, of soda, of lime, etc. Nitre, or saltpetre, is thus often formed in cultivated lands, whence it passes into the juices of plants. This fact can be illustrated thus: it is a well known fact that beets and tobacco grown upon strongly manured land, and also rank plants growing on manure heaps, such as *henbane*, thorn-apple, etc., contain so much nitre, that when dried they emit sparks, when burning, like paper which has been dipped into a solution of saltpetre.

Nitric acid is also naturally formed by the passage of electricity through the atmosphere. The air consists of nitrogen and oxygen *mixed* together. When an electric current is passed through a quantity of air, a portion of the two gases unite together chemically; so that every spark that passes, a small portion of nitric acid is formed. This effect can be produced by an electrical machine. A flash of lightning is nothing more than a large *electric spark;* and hence, every flash that crosses the air, produces along its path *nitric acid.* When thunder-storms are frequent, much nitric acid and some ammonia is formed in this way. They are washed down by rains, in which they have been frequently detected, and thus reach the soil, when the acid combines with potash, soda, lime, etc., and form nitrates.

The *soil* and the air, then, are the great fountains of nourishment for the vegetable world. The soil provides for the mineral matter carbonic acid, humus or mold, water, ammonia and nitric acid. The air, too, provides all these, except the mineral matter, and humus or mold.

CHAPTER III.

HOW PLANTS VEGETATE AND GROW.

Plants and animals constitute the two great departments of organic nature. They consist of those organs necessary to sustain life, to promote growth, and to reproduce their own species. Plants, as well as animals, are endowed with *vitality;* but they differ from animals in not possessing *sensation.* Skillful cultivation always increases the productiveness of plants, and in many cases improves their quality to such an extent as to render what was once worthless now highly valuable. Apples, potatoes, and tomatoes, are examples of plants reclaimed from a wild and almost worthless state, to one of the highest value and importance.

GERMINATION.

The plant is first found as a *germ* in the seed from which it springs. For example: place a bean in warm water, and let it remain a few hours until it becomes swollen; then separate the two lobes of which it is formed, you will discover, near what is called the "eye," the germ, consisting of two parts, one to be developed into roots and the other into the stalk and leaves of the plant. When a seed is placed in a moist, warm soil, it soon begins to swell and absorb water, and also oxygen from the air mingled with the soil. A chemical change begins at once within the seed, by which the material of the grain is so modified as to become the food of the young plant. By fermentation the starch and gluten in the seed become soluble, and enters into the circulation of the germ, which begins to expand and soon bursts the seed. It "sprouts," sending forth two branches, one of which turns downward and puts forth *roots;* the other turns upward, to seek the light and air, and is soon developed into the *stalk* and *leaves.* In the meanwhile the grain has been consumed, the plant being now able to obtain nourishment from the soil, through its roots, and from the air, through its blades or leaves.

The covering of the seed is called its *integument* (bran); the starchy part within the "bran," and surrounding the *germ*, is called the *albumen*. The integument and albumen together form the seed-lobe. When a seed consists of only one lobe, it is called a *one-lobed* plant, as Indian corn. If the seed has two lobes, as the bean, the plant is called a *two-lobed* plant.

The stems of plants whose seeds have only one lobe, increase in size by *internal growth*. Such plants are called *endogens*. The stems of plants whose seed have two lobes, generally grow by the formation of layers on the *outer* part of the stem, immediately beneath the bark, or by external growth. These are called *exogens*. The *grasses*, wheat, corn, palms, and plants generally having the veins of their leaves parallel, are *endogens*. Beans, peas, and the trees and shrubs of our forests are *exogens*.

Tissues of Plants.—The various organs of plants are composed of different kinds of structure, called *tissues*. These are made up of *fibre* or *membrane*; or both together. There are five kinds of tissue: first, cellular tissue; second, woody tissue; third, vascular tissue; fourth, vasiform tissue; fifth, laticiferous tissue. Cellular tissue is composed of minute cells, resting upon and pressing against each other, so that the sides where they meet become flattened, and give to the cell a somewhat regular form. Woody tissue has a fibrous structure, the fibres being in the form of slender tubes overlapping each other at their extremities. It is this structure which gives strength to wood, and various kinds of fibrous materials used in the arts, such as flax, hemp and cotton. Vascular tissue resembles the woody in external form, but differs in having a long, slender fibre coiled within it from end to end. Vasiform tissue consists of tubes much larger than those of the woody fibre. These tubes may be seen in the cross-section of oak wood. It is chiefly through these that the sap passes in ascending from the roots to the leaves. Laticiferous tissue consists of very small tubes and cells, found most abundantly in bark and leaves. After the sap has been prepared in the leaf for nourishing the plant, it is called *latex*. Those vessels of the leaf in which this preparation or elaboration goes on, and those which afterward convey the latex back to the part of the plant to be nourished by it, are formed of the laticiferous (latex) tissue.

These various kinds of tissues hold and transmit the fluids of the plant, the different tubes and cells having no communication with each other except through minute pores. These vessels are sometimes charged with liquid matter, and sometimes with gases.

Bark.—The bark is the external covering of the plant, and may be regarded as enveloping every other part of it, except the extremities of the roots and the stigma of the flowers. The outer bark is composed chiefly of cellular tissues. The inner bark consists of cellular and woody tissues. There are little openings in the outer bark called *stonata* (mouths). These are very minute, requiring the aid of the microscope to see them. They are most numerous on the surface of leaves on parts of the plant of recent growth. These mouths perform important offices, in taking up moisture and gases from the air.

Glands are minute masses of cellular tissues, of various forms, and situated in various parts of the plant. Their office is to elaborate and discharge the peculiar secretions of the plant. The germs, oil, etc., are secreted by glands.

ROOTS.

The roots serve the double purpose of sustaining the plant in its proper position and of absorbing from the soil its appropriate food. Their office being somewhat similar to that of the mouths of animals, they take in both food and water.

Roots have a great variety of form: first, the *ramose*, or *branching*, as those of trees or shrubs; second, *the spindle*, as the radish or parsnip; third, *tuberous*, closely resembling the potato, formerly regarded a tuberous root; but the proper tuberous root has no *eyes* or *buds*, while the potato has, and, therefore, is properly classed with the underground *stems*; fourth, *fibrous*. Wheat, corn, and most of the grasses have fibrous roots; Indian corn has, in addition, a still different kind of root, called *brace roots*. They serve to support the plant, and at the same time collect nourishment from the soil.

Parts of the Root.—Tap root is the main body of the root, generally descending vertically into the soil. The *fibrils* are branches off from the *tap root*, often passing into many subdivisions. The soft, spongy, pulpy points of the branch roots are the *mouths*, through which the plant absorbs its food from the soil.

THE STEM.

The *ascending* of the stem, and the descending of the tap root, seem to be owing chiefly to the *mysterious influence of light*. This can be shown by experiment, in this manner: plant seeds in a box of soil, with straw or moss spread over it, and narrow strips of wood placed over all, so that the contents of the box will not fall out when inverted; turn the open side downward over a mirror or a bright surface of tin, so that the light will reach the soil *only from below*, and the seeds *will germinate*, the *stem* will *descend* toward *the light*, whilst the roots will *ascend into* the dark soil above it.

Functions of the Stem.—These are: first, to convey *the sap* from the *roots* to the *leaves*, where it is *prepared* for the nutrition of the plant, and thence to carry it to the various parts to be nourished by it; second, to sustain the *leaves*, *flowers*, and fruits, so as to expose them properly to the action of air and light.

THE LEAF.

The leaf combines, in an eminent degree, the useful and the beautiful. The almost countless shapes, from the straight and slender blade of grass to the deeply lobed oak leaf, and the broad *palm*, present *to the eye* a wonderful variety of nature's handiwork. *The green color*, the most pleasant to the eye, seems to have been provided by a wise Providence to soften the bright glare of a summer's sun, and thus promote the comfort of His creatures. To the plant itself *the leaf* bears the most important relation. It is the *breathing* organ of the plant—*its lungs*, as also the *digestive* organ—*its stomach.*

Functions of the Leaf.—When the sap of the plant ascends from the root to the leaf, it carries with it in solution a portion of the material necessary for the nourishment of the growing plant, but this food is still in a crude form, and too diluted to be adapted to the purposes to which it is designed; it must, therefore, undergo certain changes. These changes take place in the leaves. The sap is condensed, that is, the surplus moisture is thrown off. This takes place through the *pores* of the leaf, and is similar to the perspiration of animals. This is called *inhalation*. The pores or mouth of the leaf are *open* in the *light* and *closed* in the *dark*.

Plants derive a large proportion of their nourishment from the air, through *their leaves*, in the form of carbonic acid gas, and they at the same time throw off oxygen. This *inhalation* of carbonic gas and *exhalation* of oxygen is called *respiration*. It is different from the breathing of animals, as the animal *inhales* oxygen and *exhales* carbonic gas. The respiration of plants goes on chiefly by day, the mouths or pores being opened by the influence of light. When the *carbonic acid gas* enters the leaf it is dissolved by the sap, and carried through the *veins* of the leaf, when it is decomposed, its carbon being retained by the plant, and its oxygen exhaled into the air.

The food taken up by the roots of plants and carried by the sap to the leaves, these meet the gaseous food of the air, forming by their solution "*crude sap*." This is changed by its circulation through the leaf, if an abundant supply of light be present. The changes which plant food thus undergoes is called *digestion*, because of its resemblance to animal digestion. When the sap has thus been prepared for nourishing the plant it is called the "*true sap*." It is then conveyed by the circulating organs to the various parts of the plant, and in some mysterious way assumes the different forms of organic structure, producing stems and leaves, flowers and fruit.

FLOWERS AND FRUIT.

Growth, decay and death mark the history of every individual upon the globe, whether plant or animal. If, then, animals and plants possessed not the power of reproduction, our world would become a bleak and barren waste. The *reproductive* organs of plants are found in the flower, which is the expansion of the flower-bud. These by their combined influence bring the seed to maturity, and thus produce the *germ* of the new plant.

The essential organs for the production of seed in any plant are called the "*stamen*" and "*pistil.*" They are not always found in the same flower. They often grow on different flowers on the same stalk. In such cases the flowers containing the stamens are called "*stamenite,*" and those containing the pistil are called "*pistilate.*" For example, Indian corn has its stamens in the *tassel*, and its pistils in the *ear-shoot.* The *tassel* then is stamenite flower, while the shoot with its silk is the pistulate flower. The stamenite is barren, the pistilate produces seed.

The end to be accomplished by the stamens and pistils is to fertilize the seed. Pollen is produced in the *anthus* of the stamens, which in the proper season fall upon the *stigma* of the pistils. Without the pollen no seed would be produced. If we cut the tassel off of an isolated stalk of corn before the silk has appeared, *no seed can be produced.* But if other tassels are near at hand to provide pollen, the stalk may produce an ear without a tassel of its own.

The *fruit* consists of two parts, the pulpy matter which surrounds the seed, and the seed which contains the germ of the new plant. In the apple, peach, etc., the pulpy matter or "*pericarp*" is the most valuable portion of the fruit. In the cereal, or grain crops, the seed is the chief value—the pericarp or skin, being the chaff or husk. Albumen, or the white, starchy mass, constitutes the larger part of cereal grains, and serves not only as food for the germ of the plant, but also constitutes a large proportion of the food for man and beast.

To any one wishing to study the manner in which plants grow, and their different parts and structure, more fully, we would recommend some good work on botany.* Our space only permits us to make use of this brief exposition as the part most interesting to the farmer.

CHAPTER IV.

MECHANICAL TREATMENT OF THE SOIL.

As sand, clay, oxide of iron, carbonate of lime, and vegetable matter make up the body of all soils, we may reduce all soils into *six general classes.* Other ingredients, such as *potash, soda, phosphates* and *sulphates* are no less essential to a good soil, but they

* Prof. Gray's work on "How Plants Grow," or Prof. Johnston's "How Crops Grow," are both excellent works on the subject.

generally form only a small portion of the whole mass. The *classes* we propose are—

1. *Sandy soil;* such as have at least seventy-five per cent. of sand. The quantity of sand may be determined with considerable accuracy by very simple means. Dry and weigh a pound of soil, and put it into a vessel which will hold a gallon or two of water. Pour clean water over it, and stir it up thoroughly, then pour the water gradually off. The sand will sink on account of its weight. By repeating the washing with portions of clear water, until the water passes off clear, the sand alone will be left, and may be dried and weighed, and the quantity of sand in a pound of soil determined.

2. A *sandy loam* is a soil which contains fifty to seventy-five per cent. of sand, which may be separated and determined as above.

3. A *clay loam* has twenty-five to fifty per cent. of sand, and the remainder chiefly clay.

4. A *clay soil* has less than twenty-five per cent. of sand, the remainder chiefly clay. The dark red clay soils have a large per cent. of oxide of iron.

5. Any soil containing ten per cent. of lime or more, may be considered a limy or calcareous soil, whether remainder be clay or sand, or both. To determine the amount of carbonate of lime in the soil, heat *two ounces* of *well dried* soil, on a piece of sheet iron, or in an iron ladle, till the vegetable matter is burnt out. Then pour over it a pint of water, and add a fluid ounce of *muriatic acid.* The acid will dissolve the lime, while it will dissolve very little else from the mass. Wash the earth with clear water several times, take the remainder, dry and weigh it,

and the loss will be carbonate of lime. This is but a rude experiment, but near enough for practical purposes.

6. A *peaty* soil is one which contains twenty per cent. of dark decayed vegetable matter. Such soils are common in low, swampy places. The quantity of peat may be determined by burning out the vegetable matter, and ascertaining the loss of weight.

Compactness is a quality of importance in a soil. It must be sufficiently firm to hold the roots of growing crops firmly in place. This is especially important in wheat or grass crops, which are exposed to the frosts of winter; yet it must not be so compact that the roots cannot readily penetrate it.

The property of absorbing and retaining moisture is important. Clay loams and peaty soils absorb the largest quantity of moisture, and retain it best, especially those peaty soils which have a large excess of organic matter in them. Pure clay soils are generally too compact, while sandy soils are too loose either to absorb or retain moisture. On level clay soil the water will stand and become *stagnant*. This is the case, also, with sandy or peaty soils, with a clay subsoil. Under these circumstances draining is necessary.

The air should be allowed to circulate freely through the soil. It carries the elements of plant food contained in it to the roots. Carbonic acid gas and *ammonia* are both furnished in this way to a considerable extent. It promotes the decay of vegetable matter present, and thus again provides food for plants. The proper chemical changes in the mineral elements of the soil are promoted by the carbonic gas and the oxygen of the air. How necessary then that the soil should be well plowed and well pulverized.

Three points must be kept distinctly in view in reducing soils to their proper mechanical condition, viz: 1st. *They must be well pulverized, so as to allow the roots of plants to spread and grow freely in every direction.* 2d. *They must permit a free circulation of air.* 3d. The *water which falls upon* the surface *must be readily absorbed*, and have at the same time *such free circulation* that any *surplus moisture* will pass off *without becoming stagnant, and without washing away the surface soil.* To accomplish these objects several methods may be pursued, *one* or *all* of which may be employed, as the condition of the land, or other circumstances, may require. We will only describe the methods best adapted to the farming operations in our own country. The *most common* and *most economical* means of giving a soil its proper mechanical condition, *is plowing*. The history of the world shows that nations have prospered just in proportion to the skillful use they have made of the *plow.* If two men, with equal force and capital, are placed on contiguous farms of equal size and fertility, they will prosper very much as they *plow.* The one who *scratches* the surface to the depth of two or three inches, will soon find both his farm and himself growing poor, while the one who breaks his land up to the depth of ten or twelve inches, will soon find it necessary to "pull down his barns and build greater."

Deep plowing is absolutely necessary on almost every farm, in order to obtain the highest profit from the soil. The reasons for this can be rendered plain enough for any mind to understand in a few sentences. The space in depth to which the *roots* of crops penetrate, and from which they derive their food is usually *limited* by the *depth* to which the *plow has run.* Beneath that point, especially in clay soils, the roots make, none or but little progress. The unbroken subsoil which is compound of clay, is not easily penetrated by rains. Hence, after the plowed mass becomes saturated, the surplus water escapes over the surface, carrying off the most valuable portions of the soil, and leaving unsightly gullies behind. *Deep plowing tends to prevent washing.*

A deeply broken soil is a storehouse for moisture, keeping *moisture* in reserve for seasons of drought. When the sun, the air and the growing crops have taken up the surface moisture, some of the roots are still deep down in the earth, where the supply is abundant. In a deep broken soil a great deal of moisture rises to the surface by *capillary attraction,* it brings with it elements of fertility in solution, and as the evaporation at the surface goes on these are left to aid in enriching the *surface soil.* A *drought* may thus *improve land* which has been *properly plowed.*

The *subsoil* plow is designed to follow the ordinary surface plow in the furrow left by the latter. By this means the bottom of the furrow is *broken* and pulverized, *without being turned up.* The surface plow then throws its next furrow upon this loosened portion of the subsoil, and so the process is continued until the whole field is broken to the depth of from twelve to fourteen inches.

There are various kinds of subsoil plows used, all of which do good work. A common *snakehead coulter* (so called at the South) extending fifteen inches below the beam, makes a very effective subsoil plow. The *wings* of the *head* should be spread about four inches and raised three inches. This implement will do very effective work.

The benefits of subsoiling are similar to those of deep plowing, already given. It also opens up a new source of fertility, for the subsoil always contains many substances needed as food for growing crops. It gives a deeper space for the circulation and retention of air and moisture. *It is akin* to draining, if the surface is level and of such character as to retain too much water which falls on it, the broken subsoil lets it pass off more freely from the surface-soil. But on level land, in cases where there is a stratum of stiff clay beneath the broken soil, there will be no outlet for the surplus water, which will remain, as in a shallow basin. *Draining* must precede subsoil plowing, else the plowing will be of no avail. If *land is level*, then *subsoiling* will be of *little service*, unless it be naturally or artificially *drained*.

One peculiar advantage subsoiling has over ordinary deep plowing, is that it gives a deeply pulverized mass, without exposing upon the surface that portion which is often unfit for such a purpose. If, for example, the sub-soil is a tenacious clay, which would quickly form a hard crust on the surface, it had best not be turned up; or if it is of *lighter color* than the surface soil it would not absorb heat so freely, and would in that respect be injurious.

In very many situations sub-soiling need not be resorted to. In very deep loamy and sandy soils it is sometimes better to run two ordinary plows, the one after the other in the same furrow—the second being set deeper than the first. In this way the surface and sub-soil are inverted, to some extent, or at least completely mingled; and where the surface has been exhausted by long tillage, its place is thus supplied by fresh soil. This method *is called trench plowing.*

The *harrow* and *cultivator* are important aids to the plow in reducing the soil to a more completely pulverized condition; in mixing fertilizers more entirely with it; in giving a smooth surface to plant or sow crops, and in covering the seeds of plants. The *roller* is an important implement on many soils When light sandy soils are cultivated in wheat or other grains, the roller is frequently necessary to render the surface sufficiently compact and also in crushing clods.

DRAINING.

In a work of this kind a short notice only can be made of this important subject. Any one wishing to inform himself more thoroughly upon the subject will find valuable information in the work by Waring, "Draining for Profit and for Health," and "Farm Drainage," by H. F. French, from both of which I have derived important information herein embodied.

The chief object of draining in agriculture is to carry off the surplus moisture from the soil. Thousands of acres of swamp lands have by this means been reclaimed from otherwise utterly worthless condition, and rendered extremely fertile; while millions of acres lie yet unreclaimed in our Southern States, producing only loathsome reptiles and insects, together with fatal *malaria*, which often renders the surrounding country almost uninhabited. Marshy and swampy lands are generally *not fertile.* First—Because the stagnant water excludes the air, and causes the vegetable matter to be converted into soluble vegetable acids in such quantities as to be injurious to most plants. Such soils are said to be "sour," and produce nothing but coarse, worthless vegetation. Second—The air is necessary to keep up the proper chemical activity in the soil in order to produce the necessary changes in its mineral ingredients. Stagnant water prevents this by exclud ing the air. Third—Swampy lands are *cold.* Water is very slowly heated, compared with soil. Hence lands covered, or even saturated with water, are not readily penetrated by the heat of the sun. Besides this, the constant evaporation which goes on from the surfree of such lands carries off heat rapidly.

Draining, by admitting the circulation of the air, promotes the proper kind of chemical changes, in both vegetable and mineral substances, and thus "sweetens" a "sour soil;" and by admitting heat and checking evaporation, brings the soil under the warming influences of the sun.

The decay of vegetable matter is hastened by draining, and the soil rendered more porous. As soon as drained lands become sufficiently dry for the plow, they should be treated with a free dressing of *quick lime*, or *unleached ashes*, to neutralize the excess of vegetable acids, and then broken up to as great a depth as possible to aid the circulation of air.

There are two modes of draining in common use. The one by surface or *open drains;* the other by *blind* or *covered drains.* The *open drains* consist of one or more *channels* or ditches running through the lowest part of the field. A natural channel or branch often serves the purpose. The land can be either bedded so as to run into these main ditches, or, if necessary, cross ditches cut, emptying into the main drains. These cross drains should have as much "fall" as possible on level land near their *mouths.* The *covered drains* are in every respect preferable to the open drains. They are constructed by digging ditches from three to four feet deep, parallel to one another, and leading into a larger or *main channel,* like the open drains. But instead of being left open, a tube or pipe is formed of tiles, broken stones, timber or coarse brush is laid in the bottom to carry off the water, and the ditch then filled up.

There are several *points* to be observed in the construction of *covered drains.* If the land is level or nearly so, the *main channel* should run along the lowest part of the land to be drained, and should have as much "*fall*" as possible toward the outlet from the field. The *side drains* should run at right angles (or as nearly so) to this, and with as much "fall" as can be given them. If the land to be drained is a hill side, the *main drain* should run along the base of the hill, but have sufficient fall to carry off the water freely. The smaller drains should run directly down the slope into the *main drain.*

The distance apart that the side drains should be placed depends upon the character of the subsoil. In stiff clay it would be best to place them from twenty-five to thirty *feet* apart. But in a gravelly, platy soil, they may be often separated by a space of fifty or one hundred *yards*. A large field, with a sandy or pebbly substratem, has often been drained by a single drain.

The drains should be made as deep as the nature of the soil and the "fall" will admit. Say from thirty to thirty-six inches, or if possible, four or five feet in depth. The great object in draining is to remove the surplus water, and give free access of air to *as great a depth of soil as possible.* The roots of crops are known to run to a great depth in soils which are in a proper condition to be penetrated by them. Indian corn has been known to send its roots down to the depth of six feet. Clover has sent its tap root down to the depth of forty-two inches. These facts have been ascertained by actual experiment. It will be found that the tops of plants vary nearly in proportion to their roots; how necessary, then, to furnish a deep, rich soil for the roots. When marshy lands are first drained they will not at once be productive. Time must be allowed for the proper chemical changes to take place, but these changes may be greatly hastened by artificial means. The application of *quick lime* or unleached ashes will help to neutralize the vegetable acids always present, and thus *sweeten* the soil.

Draining in clay soils is one of the best preventives of drought. Stiff soils are generally very wet during the winter and spring; the whole mass of plowed earth is like a bed of mortar, and settles down very compactly. If this land has been drained and subsoiled, the surplus water settles down at once and is carried off by the drains, while during a drought enough moisture soaks upward to supply the plants and keep them in a growing condition.

CHAPTER V.

CHEMICAL TREATMENT OF THE SOIL.

Having considered the *mechanical treatment* of the soil, let us now take up the *chemical treatment*. A soil may receive all the attention possible in the way of plowing, draining, etc., and still not be *productive*. It may lack the proper *chemical* elements necessary to supply the wants of the growing crop.

On the following page we give a comparative table of ashes of crops, showing the exact quantity contained in each crop:

ASHES OF CROPS.

Composition of 100 pounds Ashes	Wheat Grain	Indian Corn	Oats Grain	Straw Wheat	Stalks Corn	Beans & Peas	Straw B & P	Stalk Cotton	Seed Cotton	Tobacco Leaf
Potash	25.7	27.2	23.4	10.0	28.6	41.06	14.58	15.50	25.30	19.50
Soda	6.1	5.3	3.2	2.7	9.6	2.03	9.56	10.06	18.30	0.30
Carbonic Acid								22.40	3.00	16.50
Lime	2.8	1.4	5.0	7.5	8.3	5.20	30.63	17.53	5.60	32.13
Magnesia	13.5	5.7	9.5	5.0	6.6	6.57	6.95	10.03	18.10	11.12
Oxide of Iron	.7	.3	.4	1.2	0.8	2.00	1.15	7.52	.30	0.64
Phosplic Acid	48.6	47.0	46.5	3.0	17.1	38.56	10.81	9.00	27.60	6.36
Sulphuric Acid	1.0	1.2	9.6	3.8	0.7	1.44	8.21	3.70	0.0	5.14
Silica	1.5	1.6	2.3	66.0	27.0	1.06	10.65	2.28	.90	7.15
Chloride of Soda	.1	.3	.1	.8	1.5	2.14	7.36	1.00	.90	1.18
Pounds of Ashes	100	100	100	100	100	100	100	100	100	100

From the foregoing table we can form an approximate estimate of the mineral ingredients needed by different plants.

If we examine the foregoing table, we see that the mineral ingredients taken from the soil by different plants are nearly all *identical* in *kind*, but vary considerably in the *proportions* in which they enter into the constitution of the ashes of different plants, or of different parts of the *same plant*. That a soil may be fertile for a particular crop, several chemical properties are essential. It must contain an *excess of mineral elements* required by the crop, to allow the roots to find an abundant supply in the limited spaces which can be reached by the *rootlets*. This would, of course, require in the whole mass of the soil much more of each element than could be removed by a single crop. *The plant food* must be in a proper *chemical condition* to be taken up by *the plant*. For example: silica in the form of *sand* cannot act as a fertilizer, because of its insolubility; but in such combinations as render it soluble, it is one of the most important elements of plant life. Wheat straw contains sixty-six per cent. of *silica* or *dissolved sand;* a corn-stalk, twenty-seven per cent. All the *outer coating* of wheat straw, *corn-stalks*, oat straw, etc., is nothing but sand made soluble by alkalies in the soil.

The *soil* must be *free from an injurious excess* of any of the *mineral* elements of fertility. Too much magnesia, or even too much carbonate of lime, may be injurious; as for instance, the chalk lands in England, which are among the least productive in that country, and also the salty spots in various portions of the Southern States. The vegetable acids are useful, but in large excess they become injurious, as, for example, in a marshy, swampy piece of ground.

Vegetable matter in a *state of decomposition* is *absolutely essential* to a high degree of fertility. In a soil having the proper *mineral* elements *alone*, a plant may come to maturity and bear seed, obtaining the necessary organic food from the air, *through its leaves and roots;* but a *full* crop cannot be expected in such a case. A soil to be *fertile*, must contain both *vegetable matter and ammonia.*

Let us place side by side the analysis of three soils differing in quality. The *first* is fertile for all ordinary crops *without manure.* The reason for this is manfest in the presence of an abandance of those substances found in the ashes of plants. The *second* is a soil which produces well, with the application of *plaster* or *gypsum*, furnishing *lime* and sulphuric acid, and *ashes* furnishing potash and lime. The *third* is a poor soil, requiring much manuring.

	Fertile.	Fertile wtth Ashes and Plaster.	Infertile.
Vegetable Matter	10.00	5.60	6.00
Potash	0.40	0.01 (def't)	Deficient
Soda	0.20	0.20	Deficient
Lime	5.90	0.80	0.50
Magnesia	0.80	0.70	0.80
Oxide of Iron	2.10	4.00	8.00
Alumina or Clay	10.70	25.60	25.30
Phosphate of Lime	0.40	0.20	Deficient
Sulphuric Acid	0.30	Deficient	Deficient
Carbonic Acid	0.00	0.00	Deficient
Silica or Sand	63.90	60.00	58.00
Chlorine	0.02	0.07	Deficient

It will be seen from the above analysis of a fertile soil, that even such a soil may have but a small per centage of several ingredients which are absolutely necessary in the production of every crop. No crop, for example, can be produced without potash and phosphate of lime; and yet those form a very small proportion of any ordinary soil. A single crop takes away but little of any one ingredient, but still repeated cultivation of similar crops for many years must greatly diminish the supply of those mineral elements found in the ashes of plants. Every bushel of wheat, every bushel of corn, every bushel of rye, &c., takes away phosphate of lime from the soil, as also every bushel of cotton seed, if the seed is not returned to the land as a manure for corn or cotton. Then again, every fatted ox carries with him a good many pounds of the phosphate of lime, to market, which came from the soil upon which his food was produced. Hence, this constant depletion must be met by the application of bone dust, or phosphate of lime.

The general experience of *the world* is *that all lands become exhausted by long continued tillage without manure.* The mineral elements become exhausted by by improper cultivation. The vegetable matter or mould in the soil is decomposed, and gradually disappears. Unless fresh portions are supplied a *deficiency* must result. *Ammonia* is still more rapidly exhausted. The material supply of ammonia in the soil is not abundant, while its volatility and chemical activity causes it to be constantly escaping, or undergoing changes of form and combination. Henue the necessity of artificial fertilizers.

From what has been said of the physical and chemical condition of soils, we may safely infer they need fertilizers. A *fertilizer is any substance which, when applied* to a soil, will *preserve* or *increase* its productiveness.

Whenever, then, we would enrich a barren waste, neutralize some unwholesome ingredient of the soil, restore exhausted lands, or supply neglected fertilizers, we must resort to the proper artificial means. To do this intelligently, requires some knowledge of the various fertilizers, their composition, mode of application, action, and influence. This knowledge we will endeavor to embody in the second part of this work, and hope we will succeed in making it intelligible to every *farmer.*

CHAPTER VI.

A STATEMENT OF LEADING FACTS.

We have found, from a chemical analysis of our usual crops, the following fixed *bases* and *acids*, viz.:

Bases—Potash, soda, lime, magnesia, oxides of iron, and manganese

Acids—Phosphoric, sulphuric, silicic, carbonic, and hydrochloric (or chlorine).

These are always found in the ashes of plants. They, therefore, *must be* in the soil in which the plant grows, or in the atmosphere which surrounds the plant. They are in the soil, in various combinations with each other, or with matter which plants do not take up. For example, some acids may exist in the soil in combination with alumina, which is never found in the ashes of plants. We rarely find potash and soda combined with sulphuric acid; we generally find them in combination with silicic acid, from which they are slowly dissolved by the action of carbonic acid.

Phosphoric acid is generally found in combination with lime in the soil, while in the ashes of plants most of the phosphoric acid is in combination with potash and soda. Sulphuric acid is found mostly combined with lime in the soil. Magnesia is absorbed by plants from its solution in carbonic or vegetable acids.

Silicic acid is probably introduced into plants as a silicate of potash or soda, or dissolved in carbonic acid water. On the outer surface of all grasses or cereals, as well as reeds and rattan, we find a layer of "silex" or flint, derived, without doubt, from the solution of sand or silex absorbed from the soil by these plants. These plants owe their support to this flinty substance, as they are wanting in woody fibre and solid heart interior; and this support is necessary to enable them to bear their burden of grain and foliage, to strengthen their sap vessels and protect them from the ravages of mildew and insects.

On examining the usual constituents of the soil, we find all the mineral ingredients of ashes sufficiently abundant, excepting the alkalies and phosphoric acid. It is *safe, therefore,* to mix a larger proportion of these ingredients in the manure we wish to introduce into the soil. They are to be found in ashes, guano, and superphosphate of lime, which are all known to farmers as the most reliable of the *saline manures.*

A certain amount of vegetable mold, or humus, is necessary to the formation of a good and enduring soil; and, though *saline manures* will often, by themselves, produce a good crop on a poor and apparently exhausted soil, *they do sometimes fail*, owing to the want of mold to retain moisture requisite to healthy vegetation, as also to the production by slow decay of carbonic acid gas required by the roots of the plant. It is proper, on poor soils, *to mix* the *salts with vegetable composts.*

When vegetable matters are allowed to undergo changes in a moist soil, there are various products formed during their fermentation, putrefaction, or slow combustion. The first changes which take place are, properly, those of fermentation, during which soluble vegetable acids are formed, amongst them acetic acid or vinegar, when the plants are rich in sugar. During this stage of fermentation vegetable matters act injuriously to plants, the soluble vegetable acids being to most of them poisonous. If lime, potash or soda be present in the soil, the acids unite with them, and are neutralized. Hence the importance of using these alkalies.

The next change is one of a different nature, in which the fibre of the wood becomes brown and rotten. *Ulmic acid* is now formed, and *next humic.* It will thus be seen that all the processes of decay of vegetable matter result in the formation of vegetable acids and humus or mold, and by the action of the air upon them, produces carbonic acid, which, in its turn, acts upon the silicates and salts in the soil, or is evolved as carbonic acid gas, which is absorbed by the leaves of plants.

It is a well *known fact* that acid matters of all kinds tend to *decompose* the minerals in the soil. Ulmic, humic, and crenic acids readily act on rocks. This has been proven by placing a piece of granite, limestone, or other rock, in a peat or muck bog, where these vegetable acids abound. The rocks, before dark and solid, come out of the peat perfectly white; the granite has lost its felspar, and its mica is decomposed, and potash and soda extracted, while only the pulverized mica remains. A rock containing lime is soon deprived of the same, and cavities are left where it formerly existed. In a similar manner all vegetable mold acts upon the minerals in the soil, disengagign from them their potash, soda, lime and magnesia.

A still further change takes place more readily in cultivated soils, the slow decay of vegetable mold producing carbonic acid gas, which is also an active decomposer of the silicates, freeing potash, soda and lime, and is a great solvent of the carbonate of lime. This decomposing agent is constantly at work during the plowing of the soil; but it is not the only agent operating to renovate the soil, for at the same time the clay and mold are engaged in absorbing the minute quantities of ammonia which descends with the falling rain or snow, or is in the air. Thus, a complicated but beautiful exchange takes place among the salts in the soil.

When we mix acids and alkalies together in the soil, the result is neutral salts; and since vegetable acids have a great affinity for ammonia, with which they readily combine, they prevent the escape of this valuable gaseous manure, and preserve it in its most available form as food for plants. It has been ascertained, by experiment, that ammonia, in combination with humic and other vegetable acids, is *actually absorbed* and *digested* by plants.

Chemistry has verified and justified the experience of ages as to the importance of composting animal and vegetable substances together in the manure heap, so as to retain in proper combination the most valuble fertilizers. But farmers are not generally *informed* as to the reason for this operation, and often commit grave errors by not knowing the principles involved. Liquid manure from the stalls, or urine, is too often allowed to escape and waste itself in drains, because the farmer is not aware of *the fact* that it is as good as a saturated solution of the best Peruvian guano, containing ammonia-producing materials, phosphate of lime, and all of the alkalies. It forms an excellent ferment to mix with the vegetable matter of the compost heap.

Caustic lime or fixed alkalies *should never* be introduced into the manure heap consisting chiefly of animal droppings, unless an abundance of vegetable mold is ready to *spread on it immediately*, to absorb the disengaged ammonia, by covering the heap with a thick layer of it. The cases where lime is required to be used are not unfrequent, as for instance, where animal offal or night-soil is composted, the odor of the manure heap would be insupportable; but by throwing in a liberal supply of freshly slacked lime, and covering the whole heap with a thick layer of moist vegetable mold or rotten wood, all the ammonia will be saved, and the compost be no longer offensive.

Concentrated fertilizers, such as guano, superphosphate of lime, and sulphate of ammonia, are now extensively used by farmers. These concentrated manures generally prove to be very efficient, but in a very *dry season* their effects are not so valuable, unless they have been composted with vegetable matter. All stimulating, quick acting manures require vegetable mold in the soil. This mold has a very great absorbing power for moisture.

In many cases the farmer cannot obtain swamp muck or peat, and hence, cannot follow the method here recommended. He can, however, raise *green crops*, say of peas, clover or buckwheat, and turn them under, so as to form vegetable mold in the soil. Whenever this is done, he may confidently rely upon a large crop from the use of his concentrated fertilizers, since the vegetable mold will retain sufficient moisture to meet any ordinary drouth.

Ashes, when they can be obtained in sufficient quantities, either fresh or leached, are a very valuable manure on sandy loams or dry soil of any kind; but they do not act so favorably on wet or cold clay soils. On fine silicious sand soils, containing two or three per cent. of vegetable mold, ashes alone are a perfect amendment, capable of supplying food for plants for a number of years. *Guano and superphosphate of lime* would add greatly to the fertility of such a soil, with an ordinary season, but would be liable to fail in one of extended drouth, unless supported by an adequate supply of vegetable mold. If so supported, they not only make the crop grow with astonishing rapidity, but hasten *materially its maturity*, say, often as much as from fifteen to twenty-five days, in point of time.

It is a well ascertained fact that all substances which will generate ammonia are known to be valuable manures, for they supply nitrogen and other elements which the plant has not the power to draw from the atmosphere. Hence the advantage of, and sometimes absolute necessity for, an artificial supply of nitrogen-ous substances to nearly all cultivated soils. We have to furnish to the soil such ingredients as are needed by plants, and which in many places are found quite sparingly in the soil. These ingredients are phosphate of lime, potash, soda, and ammonia which, with mold and the other mineral manures already in the soil, will produce plentiful crops. Other matters introduced into the soil are classed as mechanical agents, and effect, principally, the texture and physical properties of the same. They frequently are as valuable as the nutritive manures themselves, in giving the soil its best mechanical qualities as to structure, as dryness or moisture, retentiveness of heat, and such a degree of porosity as to enable the air to penetrate deep down into the soil. Charcoal powder acts mechanically in absorbing ammonia and moisture from the air, and also, by its color, in absorbing the heat of the sun's rays, and retaining the heat by imperfect conduction. Charcoal is undoubtedly a powerful fertilizer, and one of great duration, as is shown by the continued fertility of the places where the Indians built their camp-fires. On the banks of James River, in Virginia, more than two hundred years ago, this evidence is strikingly shown. Nothing peculiar to these spots can be discovered, beyond the admixture of large quantities of charcoal and oyster shells with the soil. Carbonate of lime, shells, marl or limestone, in excess, is also highly useful in any soil; as it stands ready to take up any acid matter, whether of vegetable or mineral origin, and on combining with them, gives off carbonic acid, which goes not only to decompose the silicates in the soil, but also rises through it to nourish the foliage of plants.

Lime also decomposes the sand or silica *directly*, displacing the alkalies and rendering the sand soluble. Clay acts mechanically in giving consistency to the soil, retaining moisture and absorbing ammonia from the air.

CHAPTER VII.

ABSORBENTS.

Charcoal, in an agricultural sense, means all forms of carbon, whether as peat, muck, charcoal, dust from the spark-catchers of locomotives, charcoal hearths, river and swamp deposits, leaf mold, decomposed spent tan-bark, or saw-dust, etc. In short, if any vegetable matter is decomposed with the partial exclusion of air, a portion of its carbon remains in the exact condition to perform the best agricultural offices of charcoal. *This carbonaceous matter*, when properly applied to manures in compost, has the following effects: it *absorbs* and retains the fertilizing gases which evaporate from decomposing matter; it acts as a *divisor*, thereby reducing the intensity of powerful manures, thus rendering them less likely to injure the roots of plants, and also increases their bulk, so as to prevent *fire-funging;* also in part prevents the leaching out of the soluble parts of the ash, and keeps the compost moist.

With these advantages before us, we must see the importance of an understanding of the modes for obtaining charcoal. Many farmers are so situated that they can obtain sufficient quantities of charcoal dust; and nearly all can obtain muck, or leaf mold. To this we will now turn our attention.

MUCK OR VEGETABLE MOLD.

By *muck*, we mean the vegetable deposits of swamps and rivers. It consists of decayed organic matter, mixed more or less with earth. Its principal constituent is *carbon*, in different degrees of development, remaining after the rotting of vegetable matter. The dark, fat, arable soil, containing much partially decomposed vegetable mold, is always considered the best land. The farmer knows that, contrary to what happens in his woodlands, this vegetable matter decreases in his fields, and so much the more rapidly as the crops are more abundant; he knows that fields rich in vegetable mold are, as a general rule, more fertile than those which are poor in the same. Accordingly as this vegetable mold diminishes it must be renewed in some way, or barrenness of soil is the inevitable result. This mass of brown, decaying matter is partly soluble, partly insoluble, partly acid and partly neutral, which, with the uninterrupted presence of air, water and heat, may be still further decomposed, and carbonic acid and water thereby evolved.

Carbonic acid and water are indispensable to the nourishment of plants; hence, in a soil rich in vegetable mold the plants grow more vigorously, because they find these ingredients ready to be absorbed by their rootlets. Vegetable mold exerts a beneficial influence upon vegetation in other ways. It loosens the soil by the development of carbonic acid; it possesses the power of attracting moisture from the air and of retaining it for a long time; and by means of the acids which it contains, it is able to abstract ammonia from the air and also from manure; hence its value in the compost heap.

The way in which "muck," or vegetable mold, is most commonly used in Virginia and the Northern States is, to collect and store in a dry state, in some convenient place near to the droppings of the stalls, and then, from day to day, to spread upon these droppings twice their bulk in *muck*. This mode of preparation requires no special skill, and commends itself to the practice of all. Any common laborer of the farm can manipulate it; and it needs no adjuncts from *chemistry*, nor from what are called "specific manures."

Next to a compost of muck and barn manures, a mixture of muck and *ashes* is the most common, and by experienced persons is considered the most profitable. It is certainly one of the most convenient mixtures, as ashes may be transported a considerable distance with little expense. The farmer who does not understand what the precise elements of ashes are, generally accords to them the great merit as a fertilizer, when really the small quantity used would have but little effect if it did not act upon the mold, or muck and render it available as food for lants. The value of ashes to be used as muck is often estimated as high as fifty cents a bushel, in an unbleacbed state. About two bushels of good unbleached ashes to the forty bushels of muck, is a fair proportion. A compost of muck and oyster-shell lime has been used with much effect. If oyster-shell lime cannot be obtained, the best unslaked stone lime is the cheapest, because it is more effective in the compost, and swells very much in bulk when air-slacked for use. One bushel of lime to fifty bushels of muck, with half a peck of salt dissolved in water enough to slake the lime to a fine powder—the lime being slaked no faster than wanted for use—and spread immediately, while warm, over the layers of muck, which should be a foot thick, is the best way. Continue the heap in this way until your materials are used up. In about three weeks a powerful decomposition will be apparent. When this ceases the compost is ready for use. The author has made, on medium land, forty bushels of corn to the acre, with twenty wagon loads of this compost, using a shovel-full of compost to the hill of corn.

A compost of twenty bushels of finely sifted muck or mold, one bushel of Peruvian guano, one bushel superphoshate of lime, the author has found to be a very active fertilizer for corn. This amount was applied to one acre of land at a cost of $7 50 per acre. The land would have produced, without fertilizing, about eighteen or twenty bushels of corn to the acre. There was gathered forty-two bushels of good merchantable corn from the acre by this extra expenditure. About one-third of a pound of the mixture was used to each hill of corn; it was dropped on the corn with a wooden scoop, so constructed as to hold that amount of the mixture.

In the Southern States, where cotton seed is so abundant, a *compost* of cotton seed, vegetable mold, and land plaster (sulphate of lime) will make a rich and powerful fertilizer. Make the compost heap of such a size and shape to suit convenience, in the following manner: A layer of cotton seed six inches in depth, over which sow a light dressing of plaster, then a layer of vegetable mold six inches in depth, and so on, until the pile is as high as desired, taking care to top off the heap with at least one foot of mold. If the materiels are very dry, the layers should be dampened with a watering pot, such as used in gardens. In a few days fermentation will set in, the *lime* and *sulphuric acid* in the plaster will *eat up the cotton seed*, which, in two or three weeks, will be entirely decomposed, while the vegetable mold will *absorb* all the valuable gaseous ingredients given off by the heat of fermentation. This compost should be made under shelter, but if not convenient to do so, a thicker layer of *mold* should be placed on top of the pile. Fifty bushels of this compost will be equal to fifty bushels of fine cotton seed in its fertilizing effect, and without the danger of killing the young plants, as is often the case when cotton seed alone is used. About one bushel of plaster (sulphate of lime), and one bushel of ashes to twenty bushels of cotton seed will be sufficient.

Dark loams or soils containing much vegetable matter are but little benefited by the application of *muck*. Such soils have long been favorable to vegetation, as they naturally abound in potash and other ingredients upon which plants are lively feeders. But even such land as this may be so constantly cropped, and its products carried away without the return of any equivalents that an application of muck may become necessary. The author has known hills and hill sides so badly treated as to become nearly barren of vegetation on the surface, and the soil itself so sharp and sandy as scarcely to show a vestige of vegetable matter; but upon the application of *muck* and manure, muck and ashes, or muck and lime composts, at the rate of fifteen to twenty wagon loads per acre, to produce again as liberal crops as they did before their original fertility became exhausted.

As to the quantity of muck to be applied to the acre, depends much on the circumstances of each case—no definite rule can be laid down. It may be observed, however, that very large accumulations of muck are not desirable on uplands. Ten or twelve per cent. of the soil would be more beneficial than a larger quantity. That amount, with the presence of proper *salts* in the soil, would supply the plants as well as if the quantity were indefinitely increased.

The time will come when the farmer will look upon *muck*, or vegetable mold, as one of the most valuable agents *Nature* has bestowed upon mankind. It will be the most economical, and, next to charcoal dust, the best *absorbent* to use in his stables, barns, sties, sinks, reservoirs and cellars; indeed it cannot be dispensed with and leave any hope of profitable farming. Steaming manure heaps should be covered with it, to absorb the gases; floors of horse-stalls should be sprinkled with it, as it readily absorbs ammonia, and renders the air elastic and pure.

Leibig, the great German chemist, said he could judge of the commercial prosperity of a nation by the quantity of sulphuric acid it consumed; and Mr. Pusey, a member of the British Parliament, said it was a good index as to the degree of civilization of a people. So we may judge of the character of an agricultural nation by the amount and use of its *muck heaps*. These muck piles are the bases of all permanent enterprise in farming; they crown the hills with corn, and the valleys with waving grain; they clothe the fields with grass and sprinkle the lawn with flowers; fill yielding branches with tempting fruits, freight ships, load railroad cars, and cover our tables with the rich productions of the earth.

CHAPTER VIII.

THE AGRICULTURAL STAPLES OF THE SOUTH.

Let us now take up the different crops cultivated in the Southern States, and apply to each, separately, the principles, facts, experiments and illustrations set forth in this work.

INDIAN CORN.

As the first and most important crop, we take up *Indian corn*, and discuss it. It may not be uninteresting to say something of the origin and history of this valuable plant. There has been much written on its Eastern origin. It did not grow in that part of Asia watered by the Indus at the time of the expedition of Alexander the Great. It is not among the productions of the country mentioned by Nearchus, the commander of the fleet; neither is it noticed by any of the ancient authors, and even as late as the year 1491 (the year before Columbus discovered America), Joan de Cuba, in his "Ortus Sanatus," makes no mention of it. It has never been found in any ancient tumulus, sarcophagus or pyramid; nor has it been represented in any ancient painting, sculpture, or work of art, except in America. But in this country, according to La Vega, one of the earliest Peruvian historians, the palace gardens of the Incas were ornamented with *maize*, in gold and silver, with all the grains, spikes, stalks, and leaves, in its exact and natural shape—a proof no less of the wealth of the Incas than of their veneration for the grain. In further proof of the American origin of this plant, it may be stated that it is found growing *wild* from the Rocky Mountains, in North America, to the humid forests of Paraguay, in South America. It is, moreover, a well authenticated fact that maize was found in a state of cultivation among the Aborigines on the Island of Cuba at the time of its discovery by Columbus, as well as other places in America first explored by Europeans.

Analysis.—We find the analysis of the ashes of the grain and stalk of corn to be as follows:

	Corn, Grain of.	Stalk of Corn.
Potash	27.2 per cent.	28.6 per cent.
Soda	5.3 " "	9.6 " "
Lime	1.4 " "	8.3 " "
Magnesia	15.7 " "	6.6 " "
Oxide of Iron	.3 of 1 per cent.	0.8 of 1 per cent.
Phosphate of Lime	47.0 per cent.	17.1 per cent.
Sulphuric Acid	1.6 " "	0.7 of 1 per cent.
Silica	1.2 " "	27.0 per cent.
Chlorine	.3 of 1 per cent.	1.5
	100.	100.

Fertilizers Proper to its Cultivation.—We can now discuss intelligibly the mineral and vegetable manures which should be applied to the successful cultivation of this important crop.

A crop of *twenty bushels of corn* to the acre will take away from the soil a considerable quantity of the "phosphate of lime;" hence at least one hundred pounds of *bone dust* should be applied to the land where this important ingredient has been partially exhausted. If cotton seed is applied to corn in the hill, no bone dust will be needed as the cotton seed contains a large percentage of the phosphate of lime, and is in itself a rich manure. The sulphate of lime, or plaster, ought to be applied to corn; it is a cheap fertilizer, and acts with wonderful effect. This salt is composed of: lime, thirty-three per cent.; sulphuric acid, forty-four per cent. Ashes, plaster, and cotton seed, composted at the rate of two bushels of ashes, *one bushel of plaster*, and five bushels of cotton seed per acre, *one handful* to be applied in the hill, will have a marked effect.

Of course it is not to be understood that we recommend mineral manures, to the exclusion of barn-yard and stable manures. These valuable fertilizers contain all the mineral ingredients in the ashes of plants, and in the very best form to be taken up by growing plants. But with all the care and labor the farmer may bestow, he can manure annually but a small portion of his land with stable or barn-yard manure; hence these mineral fertilizers become a necessity, to enable him to make a general and extensive application.

Lime, plaster, and ashes, composted with swamp mud or mold from the woods, and scrapings from the ditch and creek banks, at the rate of one bushel of lime, two bushels of ashes, one bushel of plaster, to twenty bushels of mold or muck to the acre, forms a valuable fertilizer for corn, applied at the rate of one pound to the hill of corn.

The most important *point* in the cultivation of this crop is the *preparation of the land* by deep and thorough plowing. Corn roots run deep enough to avail themselves of the benefit of all the soil which the plow can break. The earing season of corn, too, is a period of frequent drouths. *Deep and thorough plowing*, in the preparation of the land, is the best preventive against drouths. The time of plowing should be determined by the condition of the soil. The winter frosts are of great service in stiff lands. These lands should, if possible, be plowed in the fall or early winter. All gross, or lands with much vegetable matter growing upon them, should be plowed in the autumn, so as to allow the vegetable matter, which is turned under, to decay and become food for plants. Bottom and all loose soils containing much organic matter, need not be broken until near the time for planting. The weed and grass seeds which have sprouted will be killed, and the corn have an opportunity to get in advance of the weeds. Soils cannot be made too mellow for corn, nor be kept too mellow during its growth.

The *distance apart* at which corn should be planted varies with the richness and physical properties of the soil. A rich soil can, of course, sustain a greater number of stalks than one which does not equal it in strength. But of two soils, both equally fertile, the one of stiff clay and the other of dark loam, the latter will bear closer planting than the former, because it absorbs more freely the light and heat of the sun; but in every instance there is a limit to the number of stalks to be left on the ground. Young farmers are more apt to err in having their corn too thick, than in having it too thin. This crop demands more than simply an abundance of nutrition from the soil; it requires a full supply of both light and heat, with a free circulation of air.

Modes of Planting.—There are two modes of planting practised by the best farmers, both of which have their advantages under peculiar circumstances. By one of these methods, the land to be planted is marked off by bedding up in parallel ridges, and at the proper distance apart for rows, varied according to the fertility of the soil. If the land is level, or nearly so, the rows are generally made straight; but if the land is hilly, they are made to wind around the faces of the hills, in such a way as to be nearly *horizontal.* The width between the rows varies from three to five feet. These ridges or beds are then split with a suitable plow, and the corn dropped into the furrow, at from one to three feet apart, and covered with a harrow or the hoe, to a depth which should not exceed *two inches*, unless the soil is very dry or sandy.

The other mode of planting differs from the foregoing in the method of arranging the rows. The land is laid off in two directions, at right angles to each other, so that one set of furrows run lengthwise, and another set run across the field, dividing the whole field into little squares. At the corners of these squares, where the furrows cross each other, the corn is dropped. The rows must be wide enough apart for a plow to run conveniently both ways between the hills of corn. In the large varieties of corn cultivated in the Southern States, two stalks are as many as will grow to full vigor in one hill. The principal advantage from the latter method is that the corn can be more thoroughly cultivated with the plow, and less hoe work is necessary. The stirring of the soil is more complete, and the grass and weeds more thoroughly eradicated, than they can be by running the plow only in one direction. The sun, also, has more free admission to the soil. This method is impracticable on steep or hilly land.

Quantity of Seed.—Each hill should have two or three times as many grains as there are stalks to be left growing. By this means, if the seed has been carefully selected and kept in a dry place, the trouble of replanting may be avoided. Another great advantage arising from an abundant application of seed is, that however perfect the grains may seem to be when planted, some will produce vigorous and healthy plants, while a few, at least, will produce only such as are feeble and sickly, and can never, by any after culture, be made productive. Five or six grains in a hill will almost always secure enough of the best quality to be left.

Every farmer should test the capacity of the different parts of his land for corn, by actual experiment. He should, on different parts of the same quality of soil, try the cultivation of *one*, *two* or *three* stalks to every square yard, until he finds out the number best suited to his soil. He will then know how thick to plant his corn, and establish rules for himself far superior to any theories he may find laid down in books. The points of the first importance in the culture of corn, after the planting has been properly executed, are: *first*, keep the ground clear of everything which has the same period of growth with the crop; *second*, stir the soil thoroughly, and to as great depth as possible, during the *early stages* of the *growth* of the crop. In clay soils, where a strong grass sod has been turned under, a good plan is to run a Coulter on each side of the row as soon as the corn has come up; the middle spaces may be stirred with a shovel-plow or a cultivator. After this one deep plowing will generally be sufficient.

Many farmers, especially in the Southern States, prefer the plan of running a small mold-board or turning plow, as near the rows as possible, at the first working, in such a way as to throw the earth off from the corn, following with the hoes to thin the corn and cover any roots too much exposed. This is followed by a second use of the same plow run in an opposite direction, so as to throw the earth back again toward the row. This method has some advantages, and is adopted in the cultivation of other crops. It gives free access of air to the soil about the roots of plants, and gives the portion of soil turned twice with the plow a complete stirring; it destroys completely the first weeds and grass which spring up near the rows. As the corn approaches the period of *tasseling*, the roots spread with great rapidity, after which deep plowing will result in great injury to the crop. All work after the corn is large enough to bunch or tassel should be done with the cultivator or hoe. The land may thus be kept clean, and the roots left to spread themselves out on all sides between rows.

Harvesting the Crop.—There are various methods pursued in *harvesting* corn. For securing the fodder there are two methods extensively employed, both of which are so familiar to every one living in a corn-growing country that a brief notice of each, with its advantages and disadvantages, will be all that is necessary.

Blading and Topping are performed where the securing of the fodder within the smallest compass, and in the most portable form, is desired. The blades below the ear, with the first one above, are stripped off with the hands and placed between the stalks standing close together, until they are sufficiently cured to be tied up in small bundles and secured in a stack or under a shelter. The blades are in order for being tied, or in any way handled only in the morning or evening, and on cloudy days. If handled in dry weather, especially if it is windy, there is always considerable loss from their breaking into fragments.

Topping consists in cutting off that portion of the stalk above the ear. The tops thus cut are allowed to lie in small heaps until partially cured; they are then tied in bundles, or put together in the form of shocks, in which condition they stand until perfectly cured. The next step is to secure them against the weather, by stacking or putting them under shelter. Both blades and tops, when secured without much exposure to rain, are about equal in value to the same weight of good hay. But to secure the full forage value of tops they must be cut into small fragments, so that the animal to which they are fed may be able to masticate them easily.

When corn tops are finely cut, and mixed with a little meal and water, horses will consume almost every fragment, and thrive remarkably well.

After *topping*, the corn is left on the stalks until it is sufficiently dry to cut. It is then pulled off with the shuck still on it, and put into a well ventilated crib, This plan is adopted in most of the Southern States, on account of the depredations of the weevil, and because it is thought to keep in a sweeter and more palatable condition. But in other States the corn is shucked and then put into the crib. A little salt sprinkled over the corn as it is placed into the crib has a good effect.

Another method is to cut the stalks off at the surface of the ground, as soon as the ears have become hard, and set them up in small stacks (shocks), to be cured by the air which circulates freely through them. In this condition the crop stands till the grain is dry enough to be put into cribs. It is then shucked, generally without being pulled off the stalk. The fodder, including the shucks, is then fed to cattle without cutting. The blades, shucks, and a little of the slender part of the stalks, are eaten, while the remainder is trodden down, and forms valuable litter to become incorporated with barn-yard and stable manure.

Another plan is that of allowing the whole plant to stand untouched until the corn is ready to be gathered; when, after the crop has been removed, cattle are allowed to gather what they will of the standing fodder. In this case, the fodder is of little value.

These respective methods have their advantages and disadvantages, and the one to be pursued must be determined by the farmer himself, according to the circumstances by which he is surrounded. The first plan has the advantage of securing the *fodder* in the most portable and most valuable form. It is especially desirable in places where hay is not easily made; but it has the disadvantage of making a lighter crop of grain. The reason of this is, that the growth of the corn ceases almost entirely as soon as the blades and tops are removed. The second plan, cutting the stalks off at the ground, has the advantage of securing the whole stalk for fodder and litter, while the corn is well secured, provided the shocks are made small, so that the air can circulate freely and prevent molding. If the corn is to be succeeded by wheat, this is the only plan by which the ground can be put in good condition for that purpose. The chief disadvantage attending this plan, is the heavy labor of cutting and stacking the corn, and the inconvenience of handling the bulky mass of fodder. The advantages of the third method are, first, the saving of labor; and secondly, of securing the heaviest product of grain which the soil and culture can produce. The disadvantages are, the entire loss of the *fodder*, the greatly inferior value of the stalks for improving the soil, below what would result from using them for litter in the barn yard.

The crop of corn should be allowed to become as thoroughly dry in the field as the season and the time required for gathering will admit. Every experienced farmer knows how readily corn becomes musty when thrown into a large bulk, in a damp condition. This often takes place around the cob, when the external condition of the ear indicates entire dryness. To guard against damage from this source, the cribs should be well ventilated. The walls should have numerous openings for the free admission of air. The floor should be elevated at least twelve or eighteen inches above the ground, to permit the air to circulate freely at the bottom of the bulk.

In this connection it may not be inappropriate to give an instance of *high farming for corn*, reported to the North Carolina State Agricultural Society, 1858, by Commissioners appointed by the Society to examine the crops and award premiums. They awarded a premium of one hundred dollars.

Statement of Mr. T. S. Harris' crop of corn, *one acre*, planted and worked as follows:

Thirty-two loads (two-horse) stable manure	$ 32 00
Spreading the same	2 50
Plowing and harrowing	5 00
Planting and seed	2 00
Hoeing and cultivation	5 00
Harvesting and shucking	5 00
Interest on land and taxes	2 50
Cost of raising	$ 56 00

PRODUCT.

Value of 102 bushels of corn at $1	$102 00
Value of 1¼ tons fodder at $10	12 50
	$114 50
Less cost of cultivation	56 00
Profit	$ 58 50

The above crop was planted on the 12th day of April, upon land plowed with a three-horse plow, and subsoiled with a snake-head coulter. The land was an average of a thirty-acre lot of upland, which would have brought, without manure, about twenty bushels to the acre; the remainder of the thirty-acre field averaged eighteen and a half bushels to the acre. After preparing the ground and planting the corn, the crop was run over four times with the plow, and the ground left level.

What is called "high farming" will pay. The same argument that holds good for a corn crop will hold good for other crops.

CHAPTER IX.

THE COTTON CROP.

We take it for granted that every intelligent planter would like to know something of the history of the cotton plant; and as all may not have had the opportunity to read its history in WAILE's valuable report of the Geology and Agriculture of Mississippi, we here insert his account as being the best that we have ever seen given, and one that must prove highly interesting.

THE COTTON PLANT—ITS ORIGIN.

The cotton plant, to which the generic term *gossypiurn* has been applied by botanists, is of the natural order malvanæ, to which the holly-hock, mallow and okra also belong. Although of comparatively recent introduction into the United States, the cotton plant was known in the earliest ages of the Old World. Herodotus describes the plant as "producing in the Indies a wool of finer and better quality than that of sheep." Pliny mentions certain "wool-bearing trees which were known in Upper Egypt, bearing fruit like a gourd, the size of a quince, which, bursting when ripe, displays a ball of downy wool, from which are made costly garments resembling linen." At the commencement of the Christian era it had become an article of commerce in the ports of the Red Sea, and the remote provinces of India had at that early period acquired a celebrity for their cotton fabrics. The popular name *cotton*, from the Italian *cotone*, is said to be derived from its resemblance to the down which adheres to the quince, termed by the Italians cotogni. Many varieties of the plant are described, and among them the perennial or cotton tree, which grows spontaneously in Brazil and Peru. The annual herbaceous varieties only are those cultivated in the United States. The average height of the plant in land of medium quality is about five feet. In very fertile soil, it attains to double that height, whilst, on exhausted and sterile, it becomes quite a dwarf. Its appearance somewhat resembles that of the okra plant, but is much more branched, and the leaves less in size and of more uniform shape. The branches are long and jointed, and bearing at each joint a boll or capsule, containing seed and the wool. Each boll is accompanied by a broad, indented leaf, springing from the same joint of the branch, resting upon a foot-stalk three or four inches in length. The woody fibre of the plant is white, spungy and brittle, but is invested with a thick brown skin or bark, which is pliant and tenacious. The root is branching, with a tap root penetrating deeply into the subsoil, and is less affected by drought than most other plants. The blossom is cup-shaped, two or three inches in length, never widely expanded, white on the first day, until noon, then changing gradually to red, closing gradually for the next day or two, with a twist over the germ of the boll, by which it is speedily detached in its rapid growth, when it withers and is cast off, leaving the boll invested by a capacious *three part, dentate calyx*, technically known as the *square*. This calyx or square, when containing the germ and flower, are liable to be disjointed, and fall, from the long prevalence of drought, but more so, when a rainy season suddenly succeeds, occasioning a second growth from the rapid elaboration of sap.

The cotton plant very often commences flowering about the 1st of June, and ceases about the 1st of November, when the plant is killed by the *frost*. The bolls are egg-shaped, rather under the size of the egg of the domestic fowl, pointed at the extremity, expanding widely when, fully mature, exhibiting a brown, tough, woody seed-vessel, somewhat horny in texture, to which the locks of fibre or lint adhere.

The culture of cotton was introduced into China about the thirteenth century, and has extended largely; the Nankin variety, especially produced there, has acquired a wide notoriety, forming a distinct fabric, which is even yet imported into this country. Georgia is said to have taken the lead in the cultivation of this plant; yet the first shipment of cotton known was in 1784, when eight bags were seized by the customhouse officers at Liverpool, it not being believed that even the small quantity of two thousand pounds had been raised in the United States. Seed was introduced into Georgia from Jamaica and Pernambuco in 1786, but the cultivation of the Sea Island variety was not established until

1789. The *upland* or Georgia (bowed cotton) was successfully introduced about the same time. Cotton was doubtless indigenous to America, having been found growing wild in the West India Islands when discovered by Columbus, and at the period of the conquest of Mexico, by Cortes, the natives made "large webs as delicate and fine as those of Holland." Their other cotton fabrics were varied and beautiful, and constituted their chief article of dress. When, and from whence the plant was first introduced into Mississippi, is not certainly known, most probably by the early French colonists from St. Domingo. It would seem its cultivation there and in Louisiana, on a small scale, for domestic purposes, preceded that of Georgia. Charlevoix, on his visit to Natchez, in 1722, saw the cotton plant growing in the garden of Sieur Le Noir, the company's clerk. Bienville states in one of his dispatches, dated in April, 1735, that the cultivation of cotton proved advantageous. It is stated that by Major Stoddard to have been cultivated in the colony in 1740, and Governor Vandreuil in a dispatch to the French minister, mentions cotton among the articles which came down the river annually to New Orleans. This dispatch was dated in 1746.

Among the *varieties of the cotton plant* may be enumerated the Sea Island, the Upland, the Tennessee Green Seed, the Mexican, Pernambuco, Surinam, Egyptian, etc.

The Sea Island is confined to a very few plantations on our seaboard. It is superior to all others in the length and fineness of its staple. It bears a high price, generally thrice as much as the best uplands, but from the expense of its preparation for market, is not considered more profitable to cultivate than the short staple.

The upland, first cultivated at the South, differs from the preceding in the color of the blossom, the size and form of the boll, and in the length and fineness of the *staple*. Both have smooth, black, naked seed. All other varieties seem to have a tendency to return to this by long continued cultivation.

The Tennessee cotton has a seed invested with a thick *green down* adhering firmly to it. It is difficult to gather, but it superseded the *black* seed for a few years, from its freedom from the *rot*—a disease with which the black seed had become infected.

They both gave way to the *Mexican*, which is now chiefly cultivated, or is the basis of all the varieties now in favor with the planter. The superiority of the Mexican variety consists in its *vigorous growth*, the size of the boll, and its free expansion, affording great facility in gathering the crop. The objections to it originally were the coarsenesss of the staple and loss sustained by its falling out, if not gathered speedily. These defects have been, in a great degree, corrected by cultivation. The Mexican seed is believed to have been first introduced by the late Walter Burling, of Natchez, Miss. He was sent to Mexico on a mission in 1806. He requested permission to import some of the Mexican cotton seed from the *Viceroy*, a request which was not granted, on the ground that it was forbidden by the Spanish Government. But the Viceroy sportively accorded his free permission to take home with him as many *Mexican dolls* as he might fancy—a permission well understood and freely accepted. Mr. Burling had these dolls stuffed with cotton seed. Many accidental varieties have been introduced of late years, originating in a promiscuous cultivation of different kinds, by which the pollen became intermixed, and the different qualities assimilated. Some new and excellent varieties have thus been produced, which have been preserved and further improved by careful and judicious selection of seed in the field. Many spurious kinds have been palmed off upon the planter from time to time. Many of them have had their day, whilst others deservedly maintain the high estimation to which their superior qualities entitle them.

CHAPTER X.

THE DISEASES OF THE COTTON PLANT.

RUST.

Many of the most experienced planters attribute this disease to the mineral properties of the soil. The leaves, when first attacked, appear rather more yellow than the rest, with red spots on the surface. These leaves turn more yellow and red every day, until the plant assumes a bright red color; when, finally, the whole of the foliage turns to a brown color and falls to the earth. When the disease attacks the bolls, it assumes a different appearance, and is termed the "red" or "black" rust, as the case may be. The cotton, in such bolls as have been attacked by the black rust, and the bolls themselves, shrivel up and turn dark colored, are mildewed and totally valueless. There are some planters who attribute this disease solely to atmospheric changes, and not to the soil. The author, from long study and reflection, is of the opinion that both theories are right; the soil stands the rust, and the atmosphere continues it. Mr. David Dixon, of Georgia, applies with his fertilizers one hundred pounds of salt to the acre, and affirms that he is now never troubled with the rust.

SORE-SHIN.

The *sore-shin* is sometimes occasioned by a careless stroke of the hoe, scraping the outer bark from the stem, while the plant is yet growing and tender. Although the vigor of the plant may afterwards produce new bark from the the sides of the wound, and the injury heal up, leaving only a scar, yet the stem eventually becomes so weak, as frequently to break off at or above the place first wounded. The preventive of this kind of sore-shin is careful hoeing. There is another kind of sore-shin occasioned, as some assert, by planting too early. The cold, cutting winds blight the young plant where it comes in contact with the ground. The plant-louse, which prevail most in such seasons, doubtless contribute to the injury.

THE ROT.

Mr. Troup, in the *American Farmer*, describes its appearance with great accuracy. He says: "The first indication is seen in a small circular spot outside of the boll, exhibiting a darker green than the other parts; as if a globule of water had been dropped upon it, and been absorbed. Many of these are frequently seen at the same time on the same boll. They spread themselves faster, or slower, as if induced either by the atmosphere or condition of the plant, changing color as they progress, until they assume a dark brown, approaching to black, and until the whole exterior is in like manner affected. When the disease penetrates to the centre of the boll, fermentation is universal, and is seen in a frothy, white liquid thrown out on the surface of the boll. Putrifaction follows, and the destruction of the seed and lint thereby becomes complete." It is very difficult to find out the true cause for this disease, as it sometimes appears in dry as well as wet years, although it is generally more destructive during rainy seasons. The young bolls are often rotted as well as the half matured and old, so that the age of the fruit does not appear to have anything to do with it. As to the theory of a defect in the soil, it has been stated by some planters that barn-yard manure will often produce it; but if this is the case, it is somewhat singular that one plant may be badly affected by the rot, while others on each side are perfectly healthy and uninjured. This fact appears to show that a great deal depends upon the constitution of the plant itself, which may have inherited the disease from its parent, and a choice of good *mature seed*, from strong, healthy plants, may remedy the disease. The fungoid growth found on the rotted boll may, perhaps, be regarded more as the result than the cause of the rot. There are three glands on the inside of the outer calyn, at the bottom of the boll, and three on the outside between the ruffile and stalk, which secrete and give out a sweet substance, which ants, bees, wasps and plant-bugs avail themselves of as food. I have seen young bolls, apparently healthy, suddenly drop from the plant, and on being carefully cut open, showed a wound which had been pierced by the trunk of some insect, in one of these glands, and a watery rot had commenced where the boll had been stung. It was evident that *this rot had been caused by the piercer of some insect.*

BLIGHT.

It is frequently observed that fine and apparently healthy cotton plants, full of forms and bolls, are suddenly dying in certain spots, the leaves wither, droop, and finally fall off, and the plant dies. On taking the plant up no worm, insect or external injury could be observed. On splitting the stem open, the pith in the heart had turned black, and the sap in the sap vessels seemed dried up. The only conclusion that could be drawn was, that some of the roots had penetrated into a soil totally unfitted for the life of the plant. What renders this disease more singular is the fact that other cotton plants were growing most luxuriantly within one or two feet, and even in the same hill with the blighted plant. It is a fact worthy of observation that this disease occurs on the very best land, and to a greater degree on land which has been overflowed in the spring, or where water seeps out at the foot of hills.

Most of the foregoing facts in relation to the diseases of cotton were condensed from Glover's report.

CHAPTER XI.

INSECTS BENEFICIAL AND INJURIOUS TO THE COTTON PLANT.

The following account of the insects frequenting the cotton plant, is from the Report of Townsend Glover, a practical entomologist, sent out by the United States Government for the purpose of studying their habits and nature. Mr. Glover spent several years in Georgia, Florida, Alabama, Mississippi and Louisiana, devoting his whole time to the subject.

INSECTS FREQUENTING THE COTTON PLANT.

The cotton plant furnishes food for numerous insects, some of which feed exclusively on the *leaf*, some on the flower, while others destroy the young buds and bolls. It is my purpose to describe these insects, not in the order of their classification by natural families, but according to the part of the plant to which their ravages are chiefly confined. Thus, by referring to the parts injured, one can easily recognize the insect, or its larva. Many of these insects at first appear in small numbers, and only do much injury in their second and third generations. For instance, a female boll-worm will produce five hundred eggs; when hatched, one-half females, the other half males. The next generation, if the increase be in the same ratio, will be 125,000 caterpillars or moths—and this accomplished in the space of three or four weeks. It will, therefore, be perceived that their destruction depends upon prompt and timely action. Planters may materially aid in the work designed for their mutual benefit, by minutely observing the habits and nature of these pests of the field, and devising means for their destruction.

Insects injurious to cotton consist of those destructive to the general crops, such as the boll-worm, cotton-caterpillar, and some others; and those which do comparatively little injury, such as the span-worm, and others which feed upon petals and pollen of the flowers. There are also many insects found in cotton fields which do no damage whatever to the plant, but merely feed upon the grass and weeds growing between the rows.

A class of insects which is highly beneficial, comprehends the larva of the lady-bird, the ichneumon of flies, and many others, that are ever on the search for living victims amongst the noxious tribes, and which serve to keep the members of the latter within proper bounds.

Several methods for destroying insects are employed, one of which—the most effective, tried in Florida—is the use of fire or burning torches. Myriads of nocturnal moths are attracted by the lights, burn their wings as they hover around, and are either destroyed at once, or disabled from flying about to deposit their eggs in distant parts of the field. Another plan, which it is hoped will, upon experiment, prove applicable to the enemies of the cotton plant, has been lately reported as a means of destroying the "tobacco fly" in Florida. This fly is in the habit of feeding upon the nectar or honey contained in flowers. They are particularly fond of the Jamestown weed. A preparation of one pint of water, a gill of molasses or honey, and an ounce of cobalt. This mixture is put in a bottle, a quill inserted in the cork. Let fall a few drops of this mixture into the cup of the flower, about sunset. It is certain to destroy the moths.

But, while planters are looking for so many artificial means to destroy insects, they are apt to overlook the great daily benefits derived from other agents, which kind nature has provided to check their increase. These agents are the *birds*, which constantly destroy insects in their varied forms—larva, pupa, or perfect insect. Mocking-birds and bee martins catch and destroy the boll-worm moth with great avidity. If the fields were plowed in the fall, many insects and chrysalides are turned to the top of the furrow slice, and either fall a prey to the ever-busy bird, or perish from frost and cold.

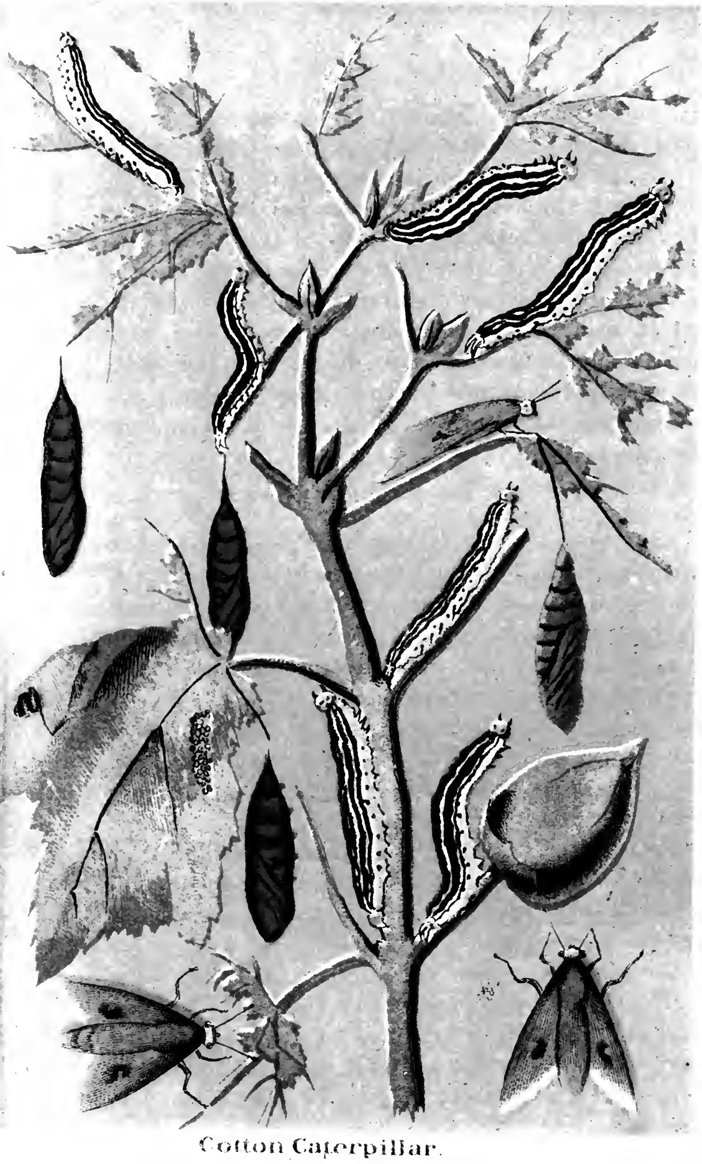
INSECTS WHICH FEED UPON THE STALK.

The Cut Worm.—The cotton cut worm is similar in its habits and appearance to many of the cut worms of the gardens; they penetrate the earth close to the plant, and at night emerge from their retreats to gnaw off the plant at or near the ground. A gentleman in Alabama, who had been troubled with this pest, informed the author that a particular spot of four or five acres, which had been overflowed in the spring, had been litterally thronging with the cut worm, threatening the loss of his whole crop. He turned into the enclosure twenty or thirty young pigs, which soon discovered the worms, rooted them up in vast numbers, and fattened on this singular diet. The cotton was not injured, as the pigs were too young to root deep enough to destroy the plants. The pigs remained where the worms were to be found, never troubling any other portion of the field.

One bushel of salt to the acre is a remedy for cut worm, and a good fertilizer, when mixed; one hundred pounds Peruvian guano, one hundred pounds of superphosphate of lime to the acre.

INSECTS FOUND ON THE LEAF.

The Cotton Louse (*Aphis*).—When the cotton plant is young and tender it is subject to the attacks of the aphis or cotton louse, which, by means of its piercers, penetrates the outer coating of the leaf, and sucks the sap from the wound. The under part of the leaves or young shoots are the places mostly selected, and the constant punctures and drainage of sap enfeebles the plant, causing the leaf to curl up, turn yellow and fall to the ground. The young lice are extremely minute, and of a greenish color; but when they become older, they are about one-tenth of an inch in length, and often a very dark green; and, in some instances, almost black. The female *produces her young alive* throughout the summer, when she may often be seen surrounded by her numerous progeny, sucking the juices from the leaf, and still producing young. Both males and females are said to possess wings at certain seasons, but the females and young, in summer, appear to be wingless. The end of the abdomen of both sexes is provided with two slender tubes, rising like horns from the back, from which exudes the "honey dew," seen sticking to the leaves, and which forms the favorite food of myriads of ants and other insects. The principal insects which destroy the lice are the *lady bug*, the *lace fly* and the *syaphus*, all of which wage incessant war upon them, and devour all they find. Another



Cotton Caterpillar.

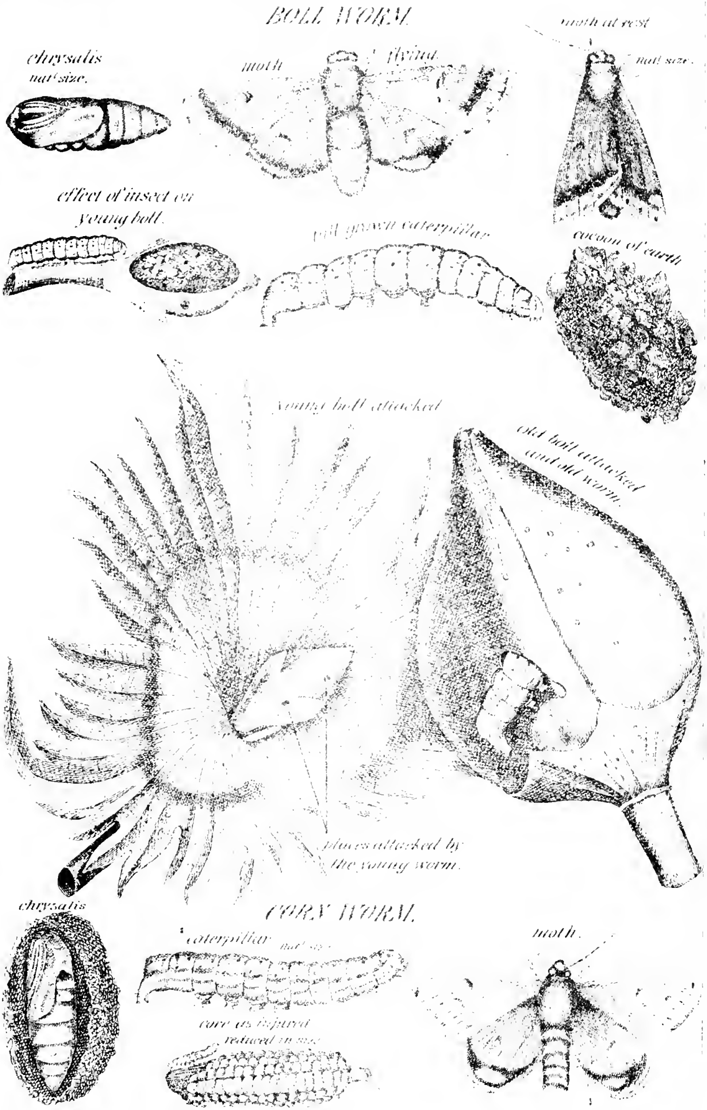
fly, the *ichnuemon*, lays an egg in the body of the louse, which, hatching into a grub, devours the inside of the still living insect, until it eventually dies, clinging to the leaf even in death, and the fly makes its appearance from the old skin of the *aphis*. Hot sunshine and the insects above mentioned are the only remedies as yet discovered for this pest of the cotton field. Dry plaster, or *sulphate of lime*, with ashes finely ground, like flour, dusted upon the plants on a damp day, would destroy many of them, and perhaps coat the leaf over so as to keep others from piercing it.

THE COTTON CATERPILLAR.

The leaves of the cotton plant are sometimes entirely devoured by what is known by the planters as the "cotton caterpillar, or cotton army worm." It does not appear every year in immense numbers, but at uncertain intervals. The perfect insect or moth, when at rest, is of a triangular shape, the head forming one, and the extremities of the wings the other two angles. The color of the upper wings is reddish gray, a dark spot with a whitish center appearing in the middle of each. The under wings are of a dark reddish gray. The moth of this caterpillar loses much of its grayish cast when it becomes older, and the down has been rubbed from the wings, when it assumes more of a reddish tinge.

The natural or perfect moths are easily attracted by lights, and may be found resting in the day time on the walls or ceilings of rooms, attracted there, no doubt, by the lights in the room the evening before. If not molested, they will remain motionless during the day; but as night approaches, they fly off with much vigor and strength. When in the open air, they may be found among and under the leaves of the cotton plant, as well as those of the weeds which surround the field. The eggs are deposited principally on the under side of the leaves, and often upon the outer calyx of the boll; I have even found them, when very numerous, upon the stalk itself. Wherever these caterpillars were very abundant, I counted from ten to fifteen eggs on a single leaf, which are very small and difficult to be distinguished from the leaf, on account of their green color. In shape, the eggs are round and flat, and, when examined under a microscope, appear furrowed or ribbed. The color of the eggs when first deposited, is of a beautiful sea-green. They are closely attached to the leaf. There is a great difference between the eggs of the "caterpillar moth" and the "boll-worm moth"—the first being, as before stated, round and flattened in shape, and green in colors; whereas, those of the boll-worm moth are not flat, but more of an oval shape, and of a dirty, yellowish color.

The first brood of caterpillars in August were all of a green color, with narrow, longitudinal light stripes along each side of their bodies, and two broader light, yellowish stripes along each side of their backs, down the center of each of which was a distinct, narrow light-colored line. Each of the broader bands is marked with two black spots on each segment; and on each segment of the sides there were three or more dark dots. The head is yellowish green, spotted with black. The caterpillars of the second and third generations, all of much darker


BOLL WORM.
chrysalis
nat' size.
moth
flying
moth at rest
nat' size.
effect of insect on
young boll.
grown caterpillar
cocoon of earth
young boll attacked
old boll attacked
and old worm.
places attacked by
the young worm.
CORN WORM.
chrysalis
caterpillar
corn as injured
reduced in size
moth.

color than those of the first. These insects appear to multiply to the greatest extent in damp, cloudy weather. When the older caterpillars are touched, they have a habit of springing to a distance of several times their length. In fifteen or twenty days after the caterpillar attains its full size, it ceases to feed. It then doubles down the edge of the leaf, and fastens it with its own silk to the main part of the same leaf, forming thereby a loosely spun cocoon. In this, it transforms itself into a chrysalis, which, at first green, but a short time after changes to a chesnut-brown or almost black color. These worms appear in successive broods, and they accomplish their cycle of transformation in from twenty-one to twenty-six days, according to the season. A season of moisture and heat is the most favorable for their production. Very *dry, hot weather*, in some degree checks their ravages.

Among the many remedies recommended for this moth, fires and lights in the fields have been spoken of as attracting and destroying the miller. If the fence corners were cleared up and burned, and the woods and ranges around each plantation were burned over, as in former times, I have no doubt a vast number of these insects would be destroyed, if not entirely exterminated.

THE BOLL-WORM.

The egg producing the boll-worm is deposited by a yellowish colored moth, during the warm evenings in summer and fall. This moth may be seen hovering over the tops of the cotton blooms from about an hour before until an hour after sunset. It flits from flower to flower, depositing a single egg on each, which hatches in three or four days, and the little worm immediately *eats* its way into the center of the enclosed bloom, or boll, and, devouring the interior, escapes to a leaf, where it soon casts its skin. The ruined bloom, in the meantime, "flares" open and falls to the ground; and the young worm then attacks another bloom or boll, in the same manner; and at length, as it acquires size and strength, it is able to bore into the nearly natural bolls, which become entirely destroyed by its punctures; for, at this period, if the interior is not all devoured, the rain penetrates the boll, and the lint becomes rotten and useless.

The worm, after attaining full size, descends into the earth, when it makes a silky cocoon, interwoven with particles of gravel and earth, in which it changes into a bright, chesnut-brown chrysalis. Those which enter the ground in September and October reappear as perfect moths by the end of November.

Whenever a young bloom is seen in the field with the calyx "flared" open, it may safely be concluded that it has been attacked by the young boll-worm, and will soon perish and fall to the ground. If the fallen blooms are closely examined they will mostly be found to have been pierced by the worm.

There is a striking similarity between this worm and the corn worm, in appearance, food, and habits, both in the caterpillar and perfect state. This leads to the supposition that the *boll-worm* may be the young of the *corn-moth*, and the eggs are deposited on the young bolls, as the nearest substitute for green corn, and placed upon them only when the corn has become too old for their food. Col. B. A. Sorsby, of Columbus, Ga., has bred both insects, and declares them to be the same; and moreover, when, according to his advice, the corn was carefully wormed, on three plantations, the boll-worms did not make their appearance that season on the cotton; although on neighboring plantations they committed great ravages.

The *worms* vary much in coloring and marking, some being brown, while others are almost green; all are more or less spotted with black, and slightly covered with short hair. These variations in color, perhaps, may be caused by the food of the caterpillar, which appears in every shade between the two. The chrysalis is of a bright chesnut-brown, and the moths of a tawny yellowish color; the upper wings are yellowish in some specimens, with a shade of green, but in others, red. There is an irregular dark band running across the wing, about one-eighth of an inch from the margin, and a crescent-shaped mark near the center of the wing. Several dark spots, enclosing a white spot, are also discerned on the margin. The under wings are lighter colored, with a broad black border on the margin, and also veined distinctly with the same color.

The destruction of these moths has been sought by various expedients. Lighted fires in various parts of the cotton field, at the season when the insects first make their appearance, have been attended with great benefit; millions, attracted by the light, perish in the flames; and if the first brood of females be thus destroyed, their numbers must be thus greatly diminished. Some successful experiments in killing these moths with molasses and vinegar, were made by Col. Sorsby, the details of which follow in his own words: "We procured eighteen common-size dinner plates, into which we put a half a gill of vinegar and molasses, previously prepared, in the proportion of four parts vinegar to one of molasses. These plates were set on stakes driven in the ground in different parts of the cotton field, with a six-inch square board tacked on top to receive the plate; each plate occupying an area of about three acres, and in height a little above the cotton plants. These arrangements were made in the evening, soon after the flies made their appearance. When examined the next morning, we found from eighteen to thirty-five flies to each plate. We continued the experiment for five or six days, extending the plates over the entire field, each day's success decreasing, until the number was reduced to two or three only to the plate, when it was abandoned as not being longer worthy of the trouble. The crop was but little injured by the boll-worm. The flies were caught, in their eagerness to feed upon the mixture, by alighting in it, when they were unable, from its adhesive nature, to make their escape. The plates should be visited every evening, the insects taken out, and the plates replenished with the mixture, as the *moths feed only at night*." We have since tried the experiment, with results equally satisfactory.

INSECTS BENEFICIAL TO COTTON.

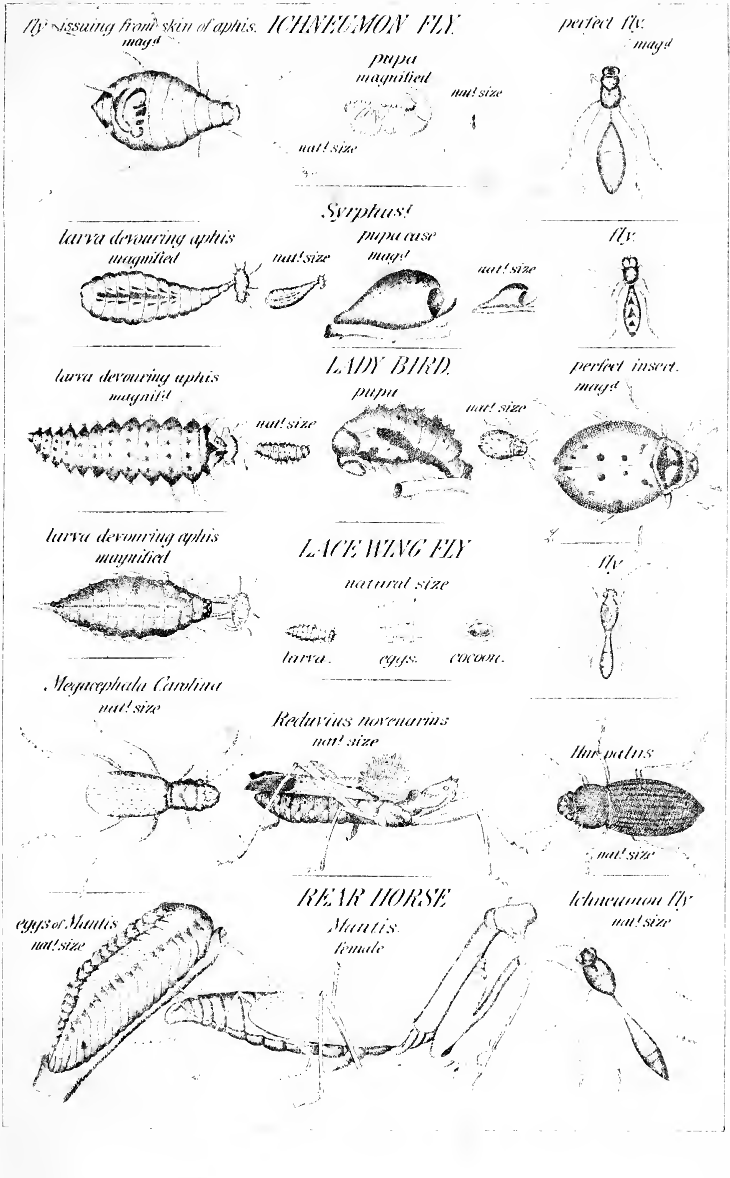
Spiders.—Spiders in the cotton or grain fields are decidedly beneficial, as they wage perpetual war against other insects, and are incessantly on the watch to catch and destroy all which happen to become entangled in their webs.

The Carolina Tiger Beetle.—This beetle belongs to the family, (cicindeledæ), otherwise called "tiger beetles," from their savage propensities, and the beautiful spots and stripes with which their metallic wing-cases are adorned. These beetles are always hunting about the ground in search of insect food. A smaller and darker species especially delight in the glare of the sun, and, when disturbed, flies only a short distance, alighting with its head directed towards the object which excited its alarm. The Carolina tiger beetle is about seven-tenths of an inch in length, of a most beautiful metallic blue, violet and green; and when placed in certain positions, it assumes the lustre of bronze or gold. It may also be known by a yellowish curved spot on the extremity of each wing-case. It is seen more frequently in the cotton fields during cloudy weather, or toward evening, than in the fervid mid-day sun.

The Predatory Beetle.—A beetle belonging to the genus *harpalus*, is very beneficial to the cotton planter, inasmuch as its food consists principally of other insects, and of dead putrescent substances. Numbers of them may be seen running about the surface of the ground in search of food. The formation of their jaws is peculiarly adapted to a predatory life; as they are very strong and hooked at the extremity, they are enabled to seize and hold fast any soft-bodied insect. These beetles destroy multitudes of insects in the larva, pupa and perfect state.

The Devil's Coach-Horse.—This insect generally abounds in the Southern States, and is very useful in destroying caterpillars which swarm on the shade trees. When young, they have abdomens of a bright red color, with dark or black spots on their backs. The head and throat are black. When they shed their skins, they are greyish in color, and have only the rudiments of wings. It is only in the last stage that they require perfect wings, when they fly with great vigor. The perfect insect measures about an inch and a quarter in length. It destroys multitudes of noxious insects, in every stage of their growth, and is therefore highly beneficial. A small specimen experimented with, was placed in a box with ten caterpillars, all of which it destroyed in the space of five hours.

The Ichneumon Fly.—An ichneumon fly is found in the cotton fields of the South, busily employed in the search of some caterpillar, in the body of which to deposit its eggs, as is generally the habit of this class of flies. The eggs being hatched within the caterpillar, the larvæ devour the fatty substance, carefully avoiding all the vital parts, until they are fully grown, the caterpillar, in the mean time, changed into a chrysalis, with the devouring larvæ in its interior, the life of the unresisting victim is destroyed, and the grubs change into pupæ and emerge from the chrysalis skin perfect *ichneumon flies*, to deposit their eggs in turn in other caterpillars. These insects are generally seen running about plants infested with caterpillars or worms, continually jerking their wings and anxiously searching every cranny and crevice in quest of a worm, in which to form the nest and provide food for their young. The ichneumon fly is


ICHNEUMON FLY.
fly issuing from skin of aphis.
mag.d
pupa
magnified
nat.l size
nat.l size
perfect fly.
mag.d
Syrphus.t
larva devouring aphis
magnified
nat.l size
pupa case
mag.d
nat.l size
fly.
LADY BIRD.
larva devouring aphis
magnif.d
nat.l size
pupa
nat.l size
perfect insect.
mag.d
LACE WING FLY
larva devouring aphis
magnified
natural size
larva.
eggs.
cocoon.
fly.
Megacephala Carolina
nat.l size
Reduvius novenarius
nat.l size
Harpalus
nat.l size
REAR HORSE
Mantis.
female
eggs of Mantis
nat.l size
Ichneumon fly
nat.l size

about a half an inch in length. The body of the female is black and marked with *seven* light-colored, yellowish, narrow rings around it; the head is black, and the eyes brown; the wings transparent, of a rather yellowish tinge, veined with black, and having a distinct black mark on the outer margin of the upper pair. The male presents much the same appearance as the female, but is more slender in form.

The Smaller Ichneumon Fly.—This ichneumon fly is not quite the twentieth of an inch in length. The head and throat black, and the legs and abdomen of a yellowish color. Although it is so extremely small as to be unobserved, it is constantly engaged in exterminating the cotton lice, myriads of which they destroy by preying upon their vitals. The female fly lays a single egg in the body of each louse, which, when hatched, becomes a grub. This grub destroys the interior substance of the louse, leaving only the grey and bloated skin clinging to the leaf; then the grub remains until it changes to a perfect fly, when it emerges from a hole gnawed through the back, and issues forth, furnished with four transparent wings, to recommence the beneficial work of laying more eggs in the colonies of lice on the neighboring plants. The number of lice destroyed in this way can be appreciated by observing the multitude of empty skins, having a hole in the back through which the fly escaped.

The Syrphus.—The young of the syrphus are found wherever plant lice abound, and present the appearance of small, yellowish, white, naked maggots, or grubs, of about a fifth of an inch in length. Their color is brown, with six distinct yellow spots on the first three segments of the body, and the sides are also marked on the margin with yellow; the body is somewhat hairy. The head is armed with powerful jaws, and gradually tapers to a point, while the tail terminates abruptly, as if cut off. The parent fly deposits her eggs amongst the lice in order to insure a supply of food to each grub. These eggs are soon hatched by the heat of the sun, and the young grub immediately commences crawling about the leaf. Being blind, it incessantly gropes and feels around on either side in search of plant lice, its natural food. When ready to change, the "syrphus" grub fastens itself to a leaf or stalk by means of a glutinous secretion from its own body, and the outer skin contracting into a pear-shaped case soon hardens by exposure to the air, and the pupa is formed inside. After a few days, during the heat of summer, the perfect fly emerges from a hole at the blunt end of the case, to lay eggs amongst other colonies of lice on neighboring plants. The perfect fly is about seven-tenths of an inch across the wings, which are two in number and transparent. The body is, generally, more or less banded brown, or black and yellow, and appears like that ofa small wasp. This fly has a peculiar habit of hovering on the wing, apparently without motion or exertion, during the heat of the day, near or over flowers. These insects are of essential aid to farmers and planters, as their young materially diminishes the numbers of lice which infest vegetation.

The Lady Bird.—The lady bird is a most valuable aid to the cotton planter, as it destroys the cotton lice by millions, and is most plentiful, where they abound, always being busy at the work of destruction, thus proving itself one of the most beneficial of insects to the planter. The larva of the lady bird is a small, blueish, black, alligator-looking insect, of about one-fourth of an inch in length, spotted with a few orange marks on the sides and back. Whenever one of them is seen among a colony of lice, the planter may safely calculate that in a few days the number of the lice will be greatly diminished. When about to change into the pupa state, it fastens itself to the tail of a leaf, the skin of the back splitting open, a small, hump-back black and orange colored pupa makes its appearance. After remaining in this state a few days, this skin again splits, and a perfect lady bird emerges, furnished at first with soft wings, which afterwards harden and serve to transport it to distant colonies of plant lice, in the midst of which the eggs are again deposited, to form new broods for the destruction of the planter's greatest pest. The perfect lady bird also destroys the lice, but not in such numbers as their larvæ. Many planters imagine that these lady birds are, in some mystorious way, connected with the appearance of the cotton louse, or even are the progenitors of the louse itself. This erroneous impression is formed in consequence of these insects being always found at the same time, and abounding on plants having the most cotton lice. I have known planters to have t! em destroyed by their field hands, when and wherev r found, and who complained that their plants were still destroyed. This result was only to be expect d, as they had killed the natural enemy to the louse, ınd suffered the pests themselves to breed in peace and safety. There is an insect which measures nearly half an inch in length, of a yellow color, with twelve large and small black spots on the wing-cases, and four small black spots on the thorax, which does considerable damage to the cucumber, melon and squash vines, by devouring the leaves, so as sometimes to disfigure and destroy the plants, which should not be confounded with the beneficial lady bird. The latter can easily be distinguished from this destructive bug, both by size and color, the useful lady bird being only one-sixth or one-seventh of an inch in length, and of a bright red, almost scarlet, color, with black spots; while the other, as before said, are yellow, with black spots, and one-half of an inch in length.

The Lace-Wing Fly.—The larva of the lace-wing fly is furnished with two long and sharp jaws, by means of which it seizes the cotton-louse, and, in a few minutes, sucks out the juices, leaving merely the white, dried skins. The eggs of this fly are very singularly placed at the end of a thread-like filament, fastened on the under side of the leaf, and generally near a colony of lice, in clusters of a dozen or more together, causing them to appear, to the casual observer, like a bunch of fungi. The eggs being hatched in the midst of the cotton-lice, the young larvæ commence the work of extermination, seizing the younger lice in their jaws, and holding them in the air, sucking out their juices, and finally throwing away the empty skins. The larvæ of this insect are not quite one-fifth of an inch in length, and are furnished with an apparatus at the extremity of their tails, by means of which they are capable of sticking to the leaf, even when all their feet are detached, thus being guarded against accidental falls during high winds, that might otherwise destroy them. When ready to change, a thread is spun from the tail, and often forming a rough sort of cob-web, the insect spins a semi-transparent ovid cocoon, from which emerges a beautiful bright-green fly, with two brilliant eyes, which sparkle like gold, and four transparent wings, of a genial cast, delicately veined, and netted with nerves, resembling the most beautiful lace work; and hence the common name. This splendid insect, however, emits a most nauseous and fetid smell, when held in the hand.

CHAPTER XII.

PLANTING, CULTIVATING, AND GATHERING THE COTTON CROP.

There must ever be some diversity of practice in the details of all agricultural operations. The character and situation of the land, the nature of the soil, the variations of the seasons, will influence these more or less. The following details, therefore, are only intended as *general directions*, under the most usual combination of circumstances.

KIND OF SOIL.

The first inquiry which presents itself is to know what are the peculiarities of those *soils* which suit the growth and maturity of cotton. Experience is the safest and most reliable test in the settlement of this question. It is now generally conceded that the best cotton lands are those which are of deep and soft mold, a sort of medium between the sandy and spongy, and those soils which are hard and close; soils which can be penetrated by the warming rays of the sun, and imbibe readily the stimulating gases of the atmosphere, and at the same time allow the excess of rain-water to settle so deep into the earth as to lie at a harmless distance below the roots of the young plant. These are *the properties of soil* needful to the vigorous growth and early maturity of the cotton plant, and the knowledge of this fact is of great, and we might add, indispensable importance to its successful cultivation. We may not find all these essentials in the selection of a farm, but by the aid of the plow, the spade, and the incorporation of foreign substances, we may remedy many defects and supply many of the peculiar demands of this plant.

Preparation of the Soil.—The best and most important part of the work in cotton making consists in a judicious and proper preparation of the soil for planting. In the varied condition in which lands are found, and the diversity of soils, we can only lay down general principles, and the results to be obtained, and leave the planters to the selection of the best means at hand for their accomplishment. All lands for cotton ought, before the crop is planted, to be broken *deep, close* and soft; and this to be done long enough before planting to allow the *rains gently* to settle them. It is the most common, and perhaps the best plan, to prepare all lands intended for cotton, in beds made by the turning-plow; and flat and wet lands, sometimes an additional elevation ought to be given, by drawing up the beds with a hoe.

In this work we have often followed too much the example of our neighbor, and have looked too little to reason, in the indiscriminate bedding and high elevation of all lands. We advocate deep, soft beds, made by thorough and close plowing, but cannot consent to the necessity or benefit of elevating much lands which are warm and dry, and which are not subject to inundations from excessive rains. For the convenience of culture, the young cotton plant should stand on a slight elevation; but when the condition of the land did not require it, we should not give it more.—[*Colonel Chambers' Essay.*

PLANTING.

The distance to be given, is the next question to be considered. This is a very important subject, and one upon which we are very dependent for success; and yet, it must be varied very much by circumstances, some of which are often beyond our knowledge or control. The *general principles* may be stated, and then the best judgment of the planter must guide him in their application.

When the crop is at maturity, the branches of the plant ought slightly to interlock every way. It would be vain to attempt to be specific in directions, which must be varied always to suit the varied character of the soil.

The planting should be in drills, chiefly, because of the difficulty of obtaining a good stand in hills. These rows ought, ordinarily, to be three and a half to four feet apart, in the medium lands of the country, and the stalks in the drill should be thinned, so as to stand twelve to twenty inches from each other. The width of the rows, and the distance in the drill, may be increased upon better lands; and in some cases, on very thin lands, they may be decreased. The rows should be run in such a direction as to give the plant the greatest benefit of the sun from early morn to its setting. Cotton is decidedly a sun-plant."

THE MODE OF PLANTING.

Here we have many plans, all setting up claim to some peculiar merit. With the preparation of the land we have indicated, it is not necessary to stop to discuss the merits of these modes, or seek to do more than to select some one which we know to answer well. We, therefore, advise the use of a small and very narrow *opener*. This should be run in the center of the bed, opening a straight furrow, of uniform size and depth. In this the seed should be strewed by a careful hand, scattering them uniformly along the furrow, and just thick enough to secure a good stand the whole length of the row. These should be covered with an iron roller or a good block, three or four inches thick, about twenty inches broad, and thirty inches long, beveled on the lower edge, and notched in the middle, so as to straddle the row. This wooden coverer, when drawn over the row, covers the seed nicely, leaving a slight elevation to prevent the settling of water, and dresses the whole surface of the bed neatly for the space of twenty inches. Thus, all clods and obstructions are crushed or removed, and a clear space is left, wide enough for the scraper in the first working of the young cotton in rough land. This is an advantage of much importance with a crop so tender and small as cotton, at this stage. From the first to the tenth of April is early enough to commence planting cotton.

CULTURE.

As soon as the young cotton is up to a good stand, and the third and fourth leaves begin to appear, the operation may commence. All that is now proposed to be done is a very rapid working with the cotton scraper and hoes, reducing the crop to bunches, soon to pass over, and return again, for a more careful working. The grass and weeds *must* be *kept down*, and the stand of cotton reduced.

The second working should follow with as little delay as practicable, the plows or sweeps, as the season requires, should be pushed forward as rapidly as possible, throwing or pushing back the earth to the plant—a process which is termed *dirting* or molding the cotton. The hoes follow immediately, thin *out to a stand*, leaving one or two of the most vigorous and promising plants, freeing them from grass or weeds, and drawing the loose soil well around them for their better support. The young stalk is very tender, and easily injured by bruises, and skins, from rough and careless work. The cut-worm and louse are charged with many sins which ought to be put down to careless working at this critical stage of the crop.

The *hoes* have much to do in the culture of this crop, and planters must be prepared to devote pretty much all their time to it. It is difficult in a work like this to say how often, and in what manner, this crop should always be worked, when the character of the seasons, and the difference in the land, must have necessarily so much to do in settling this question. As a *general rule, keep the earth loose* and well stirred; the *early workings to be deep and close*, and as the crop comes on, and the fruit begins to appear, let these workings be less *close* and *shallower*, keeping the soil soft and clean.

It is of *great importance* to work this crop *late*, and it should not cease until the branches lock, or the cotton begins to open. It is not necessary to pile the earth, in large quantities, about the roots of cotton, but the tendency of all the workings, to push some earth under, and up to the plants. The *late workings* should be *very shallow, so as not to break the roots of the plant.*

SELECTION OF SEED.

The selection of seed is an interest not to be disregarded. Planters have been *humbugged* a great deal by dealers and speculators in seed, yet we would greatly err to conclude no improvement could be made. We should, however, save ourselves from this sort of imposition, and improve our own seed by going into the field and picking, each year, from some of the best formed and best-bearing stalks, and thus keep up the improvement. Great benefit may often be derived by changes of seed in the same neighborhood, from difference of soil, and occasional changes from a distant and different climate.

The *picking*, ginning and packing of cotton is reduced to such a speedy and scientific operation that it is unnecessary to treat of them in a work of this kind.

The Manures, both Home-made and Artificial, suitable for the Cotton Crop.—Every kind of compost, green crops turned in, cotton seed, and even naked leaves listed and left to rot, improve this crop. But let us examine an analysis of this plant before we discuss the manures suitable for it:

ANALYSIS OF THE COTTON PLANT.

Composition of 100 pounds of Ashes.	COTTON STALK.	COTTON SEED.
Potash	15.50	25.30
Soda	10.06	18.30
Lime	22.40	5.60
Carbonic Acid	18.53	3.00
Magnesia	10.03	18.10
Oxide of Iron	7.52	.30
Phosphate of Lime	9.00	27.60
Sulphuric Acid	3.70	0.00
Silica	2.26	.90
Chloride of Soda and Potash	1.00	.90
	100.	100.

Of course all green or dry plants, and especially cotton seed, stalks, and leaves, when well rotted, will make a good compost for the cotton crop. When planted on cotton seed, and sometimes on strong stable manure, it is difficult to retain a stand, owing, probably, to the stimulating effects of these strong manures. So, on leaves from the woods, unless well rotted, in consequence of the leaves decaying away, and exposing the roots too much to the sun and rain. These materials, by being composted with gypsum or land plaster, and woods earth at the rate of one cart load of stable manure or cotton seed, one load of woods earth and two bushels of land plaster, well mixed together, will form an excellent manure, and there will be no risk in the use. The plaster is the *sulphate of lime* composed of sulphuric acid and lime, it therefore furnishes both the acid and lime to the plant, and also eats up or rots the cotton seed, and the litter in the stable manure. The cotton seed furnishes phosphate of lime, pötash, soda, magnesia, carbonic acid, and, in fact, all the ingredients necessary for the plant. The stable manure furnishes all these also in the very best condition to be taken up by the plant.

The only qestion in reference to using these manures is the *cost*, and the time and trouble of applying them. It *will pay* to keep one hand with mule and cart constantly employed collecting and composting manures.

COTTON SEED.

Manuring with Cotton Seed.—If a soil, equally adapted to corn and cotton, will continue to produce remunerative crops of corn for thirty years without rotation or manure (as many of the prairie and bottom lands have been known to do), then its productiveness for cotton might reasonably be expected to continue for more than a century; providing, always, that the stalk, leaves and *seed* be returned to the soil. In view of the fact just stated, how improvident is it that we should allow to be wasted annually hundreds of thousands bushels of *cotton seed*. So long as cotton is our staple (and "cotton is king"), we cannot afford to lose a bushel of cotton seed. We cannot afford to apply it as a manure on a large scale to anything but our *cotton crop*. If applied to corn, the interest realized will fall far short of that which would have been received had it been applied, in a proper manner, to the cotton field.

Manner of Applying Cotton Seed.—It is commonly stated that the cotton seed is a better manure for *corn* than *cotton.* It is strange that cotton should form an exception to a *rule* so well established, *that each plant is its own best manure,* but the present *manner of applying* the cotton seed manure may bring about such a result. The young cotton plant is less hardy than corn, and the contact with its roots of hot, fermenting cotton seed, seems to act in the same manner as an overdose of fresh stable manure would in other cases. On the other hand, it is well known that if fermentation or decay of cotton seed is allowed to progress too far, or to terminate before the seed is used as manure, the *energy of its action* is very sensibly lessened. Probably the best method of avoiding both inconveniences, would be to allow the cotton seed to decay in the ground itself, introducing it into the soil some weeks, or even months, *previous* to the planting of the cotton. When the seed ferments, the soil above them will absorb and retain the valuable gases arising from the fermentation. Thus: run a furrow in the middle of the future bed, scatter the seed in it, then lap enough earth over this center furrow and the cotton seed to bury them thoroughly—just before planting bed up in the usual manner. The tap root and its fibres will then reach and assimlate the nourishment contained in the cotton seed at the period when the plant is not only able to bear, without injury, the powerful stimulus, but is most particularly in need of it. Another method is to compost the cotton seed, as described in chapter VII, part first, of this work, with land plaster or sulphate of lime, and woods mold in the proportion of one bushel of plaster to twenty bushels of seed, and twenty bushels of mold. If one-half of a bushel of fresh slaked lime be added, the decomposition of the seed will be greatly hastened.

Feeding Cotton Seed.—We cannot afford to feed cotton seed to our cattle, unless we *keep them at home* and *collect the manure*, to be *scrupulously* returned to the soil from which it was derived. The cotton seed will take away from the soil, upon which a bale of cotton has been grown, *twice* the amount of mineral ingredients necessary to produce twenty bushels of corn. Hence the *absolute necessity* of returning the cotton seed to the land in some form, either as seed or animal manure. Some planters object to using cotton seed as manure, on account of the time and cost of its application. But if the seed has been well *rotted*, and in a fine state of division, one of Schofield's manure distributors, or other implement of the same kind (such as are now used in the State of Georgia), will distribute the manure in the drill very rapidly and effectively. These implements can be so regulated as to distribute the fertilizers in large or small quantities, according to the fertility of the soil.—[*Dr. Hilgard's Geological and Agricultural Report for State of Mississippi, 1860.* ,

Cotton seed as a manure, is one of the richest and best that nature has provided for the planter—suitable for any kind of crop or any kind of soil. What fatal economy, then, to feed or sell the seed, and rob the land.

For the application of the artificial fertilizers, we will take up and examine the experiments of others in their use. First upon the list, let us take Mr.

David Dickson's plan. He says, in a letter on the subject to the *Southern Cultivator*, December 5th, 1868: "I will now give you a plan that will carry the cotton crop through eight or ten weeks of drouth with safety, and enable it to get ahead of the caterpillar. The boll-worm may come too soon for a full crop, but one need not fear the caterpillar, if they do not come before the first of September. Always remember the soil must be good and deep, and subsoiled six inches deeper, and furnished with a good supply of *Peruvian guano, dissolved bones, plaster and salt* (one hundred pounds of each). A cotton plant, to stand two weeks' drouth, must have four inches soil and six inches subsoil; three weeks', six inches soil, and same subsoil; four weeks', eight inches soil, six inches subsoil; and to stand ten weeks' drouth, sixteen inches soil, with six inches broken below.

This plan will hold the forms and bolls during the whole time, and not give them up when it rains. If you prepare your land and carry out this *plan* well, you may expect from four hundred to eight hundred pounds of *lint* per acre, according to the character of the land.

Mr. Jas. H. Wilkins, of Bellemonte, Jefferson county, Georgia, under date of December 7, 1868, gives the following statement of the relative value of the different fertilizers in the production of cotton. The experiment was tried on twelve acres, allowing one acre to each fertilizer:

NAME OF FERTILIZER.	No. of lbs	Cost p'r Acre.	Total yield	Without Manure.	Gain.
Peru. guano, Salt, plaster, Chesapeake phos., 100 pounds each. ...	400	$ 10 50	12,65	500	765
Cotton seed, 50 bushels.................	1,400	10 00	750	500	250
Cotton seed, 40 bush's, 50 pounds P. g'no, salt, plas. & Ches. phos ...	11,00 200	13 25	1,062	500	562
Stable manure, loads........................	13	10 00	10,13	500	513
Reynold's Ches. phos.......................	235	8 00	745	500	245
P. guano, salt, plaster & soluble Pacific g., 100 pounds each ...	400	10 50	944	500	444
Soluble Pacific guano........................	200	8 50	912	500	412
Eureka Ammo. super. phos.............	240	9 00	882	500	382
Nonpariel French Poudrette...........	340	8 75	600	500	100
Lester's bone phos...........................	225	6 25	740	500	240
Peruvian guano.................................	165	8 25	883	500	383
Peruvian guano, salt, plaster, Lester's bone, 100 pounds each..........	400	10 25	1,182	500	682

Mr. Wilkins writes: "I send you the result of my experiments with fertilizers, on twelve acres. The soil is what would be termed red, stiff land in this country. The land was broken up seven (7) inches deep in January, with turning plows. On the 2d of May it was run off with a long six (6) inch scooter plow—the rows run three feet nine inches apart. A wide, very long shovel plow was then run in the scooter furrow, the fertilizers then applied, in the furrow, and the rows bedded with a turning plow.

The seasons were favorable until the middle of July—then about three weeks parching, dry, hot weather. Though the balance of the season, was very propitious, yet the cotton never recovered from the effects of the hot weather in July. The caterpillars made their appearance in September, and did some damage—perhaps a loss of two hundred and fifty pounds to the acre.

I manured all my cotton with fertilizers (mostly the manipulations Nos. 1 and 2) and am well pleased with the result. My crop averaged nine hundred and fifty pounds of seed cotton to the acre. I shall hereafter use none but the manipulated, commonly known as 'Dickson Preparation.'"

Experiments with different fertilizers, applied at a cost of $10 per acre, made by James Davidson, Woodville, Georgia; reported, December 14, 1868:

	KINDS OF MANURE USED.	No. of lbs.	Yield Seed Cotton lbs.	Yield no Manure lbs.	Inc'd yield.
1	No manure		630	630	
2	Peruvian Guano	200	1108	630	478
3	Wilcox G. & Co., M. Guano	231	880	630	250
4	Peruvian, Phoenix, Plaster, Salt	357	1018	630	388
5	Peruvian, Plaster and Salt	415	916	630	286
6	Ried's Am'd Phosphate	333	972	630	342
7	Ried's Phosphate	500	794	630	164
8	Rhode's Phosphate	286	760	630	130
9	Pheonix Guano	286	796	630	166
10	Augusta Am'd Phosphate	440	632	630	2

No. 4.—Composed of ¼ Peruvian guano, ¼ Wilcox's, ¼ Plaster, and ¼ Salt.
No. 5.—Composed of ⅓ Peruvian guano, ⅓ Plaster, and ⅓ Salt.

These fertilizers were distributed evenly and accurately in the drill, with "Schofield's Tin Guano Distributor," and then bedded up in the usual way.

The "boll worm" made its appearance about the 15th of August, in great numbers. Its ravages and destruction of young bolls were incredible. About the 1st of September the caterpillar entered the field, and literally, with the exception, now and then, of a small space, stripped the whole surface. Under these circumstances the crops did not average more than one-third to one-half."

So, it seems, from the above experiments, that, notwithstanding the ravages of the worms, two hundred pounds of Peruvian guano made an increase of four hunded and seventy-eight pounds of seed cotton to the acre.

In Mr. Wilkins' experiment, one hundred pounds of Peruvian guano, one hundred pounds plaster, one hundred pounds salt, one hundred pounds Chesapeake phosphate of lime, made an increase of seven hundred and sixty-five pounds of seed cotton to the acre—although he lost two hundred and fifty pounds to the acre by the cotton caterpillar—at a cost of ten dollars and fifty cents per acre. This fertilizer is usually known as Dickson's preparation, and seems, from experiment, to be the best proportions to mix these artificial fertilizers.

Let us examine, and see why this preparation acts with such wonderful effect. By the analysis of Peruvian guano, we see it contains: organic matter, thirty-six per cent.; ammonia, seventeen per cent.; phosphates, twenty-three and a half per cent.; alkaline salts, nine and a half per cent. [See appendix.] The plaster or sulphate of lime is composed of *water*, thirteen per cent.; *lime*, thirty-three per cent.; sulphuric acid, forty-six per cent. [See appendix.]

The Chesapeake phosphate is bone-dust, made soluble with sulphuric acid.

Salt is muriatic acid and soda.

The Peruvian guano furnishes ammonia; organic matter, which is made soluble by the sulphuric acid of the plaster; phosphate, which is acted upon by sulphuric acid, and alkaline salts, which are acted upon by the muriatic acid in the common salt, and by the sulphuric acid.

The plaster or sulphate of lime is acted upon by the muriatic acid of the salt, its sulphuric acid set free, which, in turn, acts upon the *bone* dust or phosphate, and on the organic matter of the guano. All the acids and salts act with powerful effect upon the vegetable matter in the soil, hastening decomposition and rendering soluble the vegetable mold, and also, to a great degree, by freeing the alkalies, *the very sand in the soil.* This vegetable mold and sand, in their turn, yield up potash, soda, lime, carbonic acid, and in the proper condition to be taken up by the roots of plants.

The action of these constituent elements of fertilizers is fully discussed in the appendix to this little work, and the author respectfully refers the reader to the deductions, experiments and illustrations therein stated.

A CAUTION TO PLANTERS.

As many of the artificial fertilizers now upon the market are put up for *sale*, and even Peruvian guano is adulterated to a vast extent, it requires a great degree of caution on the part of the planter in purchasing such articles. The only safeguard is to buy these manures from perfectly reliable and responsible dealers, who are willing to guarantee the fertilizers to be equal to the *standard* of value branded upon the bags and barrels, and as published in their advertisements in the public journals.

AN EXPERIMENT MADE BY THE RAINS, IN 1868.

On the plantation of a brother of the author, in Attala county, Mississippi, there is a piece of land containing one and one-half acres. It is immediately below and adjoining the *horse-lot;* so situated that the washings from the lot spread very equally over the land below it. *The rains from the clouds manure* *the land*, by leaching out the ingredients from the droppings of seven mules and two horses. Now for the result: this acre and a half produced *a bale and a half of good cotton*, whilst on the rest of the plantation, on account of the *cotton caterpillar* and boll-worm, one hundred and sixty acres planted, only produced forty bales of cotton. The worms attacked the cotton on the lot, as well as on the rest of the plantation, but the fertilizers had so *matured* the crop on the lot as to bring about the above result. This year, 1869, the same lot is planted in cotton, with the same or better result. *High manuring will pay on the cotton crop.*

CHAPTER XIII.

CULTIVATION OF WHEAT, RYE AND OATS.

PREPARATION OF SOIL.

Deep plowing is not so necessary for wheat, rye, and oats, as it is for corn; because their roots do not run, naturally, deep; nor does their season of growth so frequently subject them to drouth. A point of great importance in the preparation of land, for *wheat* especially, is that it shall be as *clean* as *possible* at the time of sowing. Grass and other green substances, whether they are plowed down just before sowing or left strewed over the surface after sowing, are often more injurious than beneficial to the crop of wheat. So, when straw or any kind of litter is spread over wheat in *autumn* or early *winter*, more harm than good generally results from the application. The injury is supposed, by some judicious farmers, to be owing, in part, to the fact, that the shading of the green crop makes it too tender near the roots to stand the severities of the winter and early spring; and that the litter or straw serves as a harbor for chinch-bugs and other mischievous insects.

When green crops or unrotted manures are plowed down for wheat, it should be done in the summer, so that they may be well decayed and ready to feed the newly planted crop in the first stages of its growth. Clover, peas, and other leguminous plants, having considerable quantities of nitrogenized matter in them, undergo speedy decay; and, therefore, may be plowed down at a later period than would be suitable for most other crops. The time for this kind of plowing in of grass and clover fields must, of course, vary to some extent with the variations of climate, soil and exposure.

The cultivation of such crops as cotton, tobacco and potatoes, is found to be one of the best means of preparing a soil *for wheat.* The benefit arises chiefly from the clean condition in which they leave the land. They also leave the soil in a favorable *chemical condition* for wheat.

The sowing of wheat after corn is regarded by the best farmers in Virginia as affording a very doubtful chance for a good crop. The chances after oats, are regarded as much more favorable, if the oat stubble is turned down early, that it may rot, while the scattered grains of oats left upon the ground may spring up, and be killed during the seeding of the wheat.

WHEAT.

*Manuring the Crop.**—Some farmers put off the application of their stable and yard manures to wheat, until winter or spring. When this is done, they are very poorly compensated for their labor. Winter wheat has two periods of growth; the first in autum, and the second, during the following spring and summer. The *vigor* of the crop, in its second period of growth, depends very much upon the *healthful* development, the roots, in the first period of growth. If, then, manure is incorporated with the soil at the time of seeding, the impulse given to the wheat plants in autum, is almost certain to continue until the crop is matured.

This always holds true, unless some *physical* cause comes in to prevent it, such as severe drought, or the depredation of insects. But when manure is spread upon feeble wheat in winter or spring, it comes too late. The basis of a good crop is not there. As well might you expect to make a great *ox* from a stinted calf, as to make a good crop under such circumstances.

Modes of Sowing Wheat.—There are two plans pursued very largely in sowing wheat. First, the old method of sowing wheat broadcast, by hand, is still kept up on nearly all the small farms, as well as many of the larger ones, and especially at the South. The slovenly method of sowing the grain among the standing corn crop, and covering with shovel plows or cultivators, is fast losing favor.

The custom of breaking up the ground with a large plow, closely, then sowing and covering with the har-

*For analysis of grain and straw of wheat, see page 41, in table.

row, cultivator or shovel plow, is still extensively used, and well suited to many soils.

The second method, is "*drilling*," which, in the past few years, has been gaining favor with the best and most progressive farmers. The greatest majority of those who have tried this method, would be willing to give it up. Some of the most important results claimed for the drill system, are as follows:

1. The quantity of seed may be regulated to suit the quality of the soil.
2. A smaller quantity of seed is used to the acre.
3. The depth of the seed is uniform, and the depth may be suited to the soil.
4. The plants shade the soil less completely, admit sunshine and air; the wheat less liable to rust.
5. Small quantities of such fertilizers as guano, plaster, ashes, bone-dust, etc., can be applied more directly to the wheat, by a proper attachment to the drill, and with more economy.

Harvesting the Wheat Crop.—The time of wheat harvest, must be determined by the condition of the grain. The cutting should be done before the crop is fully ripe, or, as soon as the grain has passed out of the "milk state,"—that is, as soon as the inner part has become firm, but is still soft enough to yield readily to the thumb-nail when pressed into it,—the crop then is at its greatest value.

The straw then is of a greenish-yellow, and there is still a green tinge about the head. If the wheat is allowed to stand three or four days after it reaches this stage, the straw and head assumes a brown appearance—the crop has become dead ripe. The grain and straw have then both become less valuable.

A portion of the starch of the grain has been converted into bran; and, according to the testimony of the best millers, it will not make as much, nor as good flour, as that which has been harvested when less perfectly ripe.

When cut in that condition, which gives the best grain, the *straw* has more starch, and more albuminous matter in it, and is therefore, more nutritious than it would be if allowed to become dead ripe.

Long exposure to rain, has an injurious effect on both grain and straw. The dark color thus produced, is owing to partial decay on the surface. When this takes place on the surface of the grain, the decayed particles become mingled with the flour in grinding, and gives it a dark shade. At the same time, repeated wetting and drying, destroys the nutritive substances in the straw. Wheat, therefore, should be placed under shelter, or carefully stacked, as soon as it has become sufficiently dry to prevent moulding or heating in bulk.

RYE.

The same remarks may be applied to rye, with some little variation, as the above for wheat.

OATS.

The best chance for a good crop, is to sow them upon corn land, or wheat stubble, of the previous year. A freshly turned soil seldom yields a full crop of this grain; but any land of tolerable fertility, which has been in cultivation the previous year, will produce a fine crop of oats.

Sowing.—The land should be plowed in the spring, or latter part of winter, and the sowing be done as early in the spring as the weather will permit. Some varieties may be sown in the fall, and will not only live during the winter, but come forward more rapidly in the spring. Their early progress often enables them to escape droughts, by which the others are cut short.

CHAPTER XIV.

PEA CROP.

We will now take up and study the pea crop, as one of the highest value in Southern agriculture. There is a large class of plants which have their seed enclosed in a *pod.* The different kinds of *bean* and pea are examples of this class. These are called "leguminous" plants. This whole class of plants is remarkable for the quantity of *nitrogen* they contain. The "ligumen" of peas is so abundant as to place them above both wheat and corn in nutritive value. The stalks of this plant also abounds in protiene matter, and in that respect, resembles clover hay in composition and value, and hence makes excellent rough forage for *stock*, hoth horses and cattle. When the vines of peas decay, *ammonia* is always one of the products. This has also been found to be one of the most valuable ingredients in *guano* and stable manure. If, then, pea crops are plowed into the soil at the proper period of growth, that is, at the time when the seeds have become firm, but not dry, considerable quantities of that valuable *fertilizer—ammonia*—will be generated in the soil. Clover seed was once regarded as almost the only suitable crop to be employed as a green manure, but experience has shown that the pea plants have a similar value; and, in some climates and soils, certain varieties of peas seem to be even superior to clover, for the purpose of plowing in as a green crop.

VARIETIES.

Different latitudes require different varieties. Those only which have a comparatively short period of growth are adapted to the Northern States. Those which require a longer season and more hot sun, are confined chiefly to the Southern States. All the varieties at the South are embraced under the general names of "cornfied pea" and "Southern pea." Mr. Edmund Ruffin, sr., in his valuable essays on this crop, enumerates *nine* varieties. First—The buff-colored pea or cow pea. Second—The bass (red) pea. Third—The black-eye pea. Fourth—The early black—has perfectly black and large seeds. Fifth—The mottled or shinny pea. Sixth—The large black or tory (late pea). Seventh—Small black (late pea). Eighth—Green-eye pea (white). Ninth—The small green or bush pea. But these are by no means all the names to the varieties of "Southern pea."

SOIL.

Crops of this class will grow well on almost any kind of land not deficient in lime. The best soil for peas is a warm, sandy loam, of *medium* fertility. A very rich soil produces a most luxuriant growth of vines, especially in the "Southern pea," but the quantity of seed is then but small. On medium soil the crop of vines is not so heavy, but the seed crop abundant. Even a very poor soil will generally produce a crop sufficient, when turned under, to add considerably to its fertility. South of 37°, north latitude, almost any soil may be restored to *fertility* from the most *exhausted condition*, by cultivating the pea, with the application of some form of *lime*, either *marl*, *caustic lime*, *plaster* or *ashes*, attended with proper *rotation*, and as frequent plowing as possible. Plowing for the pea crop should be deep and thorough. The roots penetrate a well-broken soil to a great depth, and as the plant gathers mineral substance largely through its roots, especially *lime* and *potash*, with sulphuric acid and phosphoric acid, these will be transferred from a lower to the higher parts of the soil, and be left by the decaying roots in a good condition, to be taken up by succeeding crops of grain, tobacco or cotton.

PLANTING OR SOWING PEAS.

The methods adopted for planting may vary with the object to be attained. If the crop is cultivated for seed and forage, the largest yield can be obtained by cultivating in rows, varying in distance according to the pea to be planted. The varieties which grow erect (bush pea) may be sown in rows two or three feet apart. Those which spread their vines, like most of the Southern peas, should be in rows from three to four and a half feet apart. If the object is to plow the pea vines under, the land should be well prepared, and the crop sown broadcast, and covered with a harrow or cultivator. The Southern pea has been cultivated in the Southern Atlantic States from time immemorial. Some of the methods pursued in Virginia and the States farther South are as follows, viz:

First method—"The oldest and most extended culture in Virginia, is to plant the peas after and among corn. When the corn is ten or twelve inches high, and has been just plowed and hoed, peas are planted in the drill between the hills of corn. One more plowing is all that is given the corn, and is all the culture required for the peas."

Second method—"The next most extensive mode of pea culture is also as a secondary crop amongst corn, but by sowing broadcast when giving the last plowing. This costs but the seed and labor of sowing. The crop all goes for manure, and is seldom ripe enough (in Virginia) for good manure."

Third mode—"And one I think the best and cheapest, to raise a pea crop for manuring, is to sow the seed broadcast on a separate field without corn." *Edmund Ruffin's Essay.*

In sowing peas broadcast to be plowed under, for wheat or other crops, the land should be broken up deeply in winter, and about the first week in June the peas sowed at the rate of one bushel, or five pecks, to the acre, and either harrowed in with a heavy harrow, or plowed in with single plows, according to the state of the land." *P. M. Edmondston, of North Carolina.*

The seeds are believed to have a higher fertilizing value than the vines, if they come to maturity, but by this time the vines have lost part of their value. The question as to the proper *time* of planting in, resolves itself into this form: "When will the seed and vines together generate the greatest amount of ammonia in the soil?"

Chemistry would reply: "When nearly all the seeds have become firm, but not dry." At this time the most forward pods will be dry, but the vines still retain much of their greenness, and contain the largest amount of *ammonia*-producing ingredients. This is the *theory* which science would present to the inquirer. The *experiments* of the most successful pea growers of the South confirm these simple deductions of science.

If the vines are to be used as forage, they may be cut off close to the ground with sharp hoes, or still better, with short, stout scythes, and cured like clover hay. Another plan, is to put up *tall, slender shocks*, supported by a small stake set in the ground, to remain until cured enough to stack, or put away in a house.

Mr. Edmonston, of North Carolina, says: "As an article of forage or fodder, there is none superior to the pea vine. Horses and cattle eat it with avidity, and in preference to any other kind of fodder. The difficulty of saving these vines, is the chief objection to their use. The writer believes that they can easily be saved, in the month of September, by placing forks in the ground, in a straight line, about six feet in height, and poles on the forks, then place rails, with one end resting on the ground, the other upon the poles, about six or eight inches apart, after the manner of an old fashioned top-stack, as it is called, leaving both ends open; upon these rails throw the vines, until about a foot deep. Throw over them straw or grass, and in a short time they will be cured," and a large amount of most excellent forage secured.

CHAPTER XV.

HAY CROPS.

CLOVER.

From the three divisions of its leaf, clover is called "*Trifolium.*" There are several varieties cultivated in different countries. The common red clover, is considered the best for our climate (Virginia). This is a biennial plant. If sown in the early spring, and not too much shaded by other crops, it produces a few blossoms the first season. When allowed to grow the next year to full maturity, without cutting, *it dies*; but if cut or pastured, it lives through a third, or even a fourth summer, and retains vigor enough to produce a tolerably fine crop.

Soil.—Clover grows best on clay loams, having a good supply of lime, in some available form; but almost any soil (not marshy) may be made to produce a good crop, by frequent applications of *ashes* and *plaster* (gypsum). The roots of clover run deep, and hence requires a deeply-broken soil.

Sowing.—The spring is undoubtedly the best time for securing a good stand of *clover*, while March and April are the safest months for sowing it, in our latitude (Virginia). January or February, farther South, or perhaps in the fall, with wheat. *Five* or *six* quarts of seed to the acre, or even *four* quarts, according to the character of the soil, is enough to secure a good stand. The seed should be mixed with something to increase its bulk. The seed for an acre may be thoroughly mixed with one bushel of *ashes* and a half bushel of *plaster*, finely ground. The seed are sown upon the surface of the land, immediately after a slight freeze, if sowed very early, and allowed to settle in the land by rains.

Cutting, etc.—If the clover is designed for hay, it should be cut at the period of its growth at which it has the greatest nutritive value. This occurs when about one-third or one-half of the heads have commenced turning brown. After this time, the *sugar* and *starch*, which abound in the green stalks, are rapidly converted into woody fibre. The first crop of the season is most valuable for hay, but the second may be cut for this purpose.

The leaves of the clover are very abundant, and constitute a very valuable part of the hay; but when the hay is dry, they are very *brittle*, and liable to be lost in making and stacking the crop. To prevent this loss, let the clover lie in the swath until the top is tolerably well cured, and then turn it over carefully with a fork, without additional tossing.

The hay may be packed away in mows, or safely stacked before it is entirely cured, if a layer of dry straw a few inches thick is spread over the mow or stack, for every foot in depth of hay. The straw absorbs the moisture of the hay, and also admits air. If there is much greenness in the hay when put up, a little salt spread over it, will not only assist in preserving it, but will make it palatable to the stock. The straw used in packing, is flavored by contact with the clover, and stock will eat it almost as well as the hay.

The pea-vine hay, spoken of in a former chapter, may be cured by a similar process as the above, and, perhaps, to better advantage than by any other method.

Gathering Seed.—The second crop is generally best for seed; because, in the first place, the heads are usually better filled than those of the first crop, and because it is more clear of weeds and foreign plants. A plan for gathering only the heads of clover, which is very effectual, is to have a light, but capacious box, swung to the axle of a pair of wheels, so that the bottom of the box shall be about six or eight inches from the ground. On the lower edge of the box, toward the horse, have a set of *fingers* (like a coarse comb), about the fourth of an inch apart. Let a careful hand tilt the box, so that the *comb* will run two or three inches from the surface of the ground, all the heads will be pulled off and forced back into the box.

GRASSES.

We have no room for the specific directions for the cultivation of all the grasses used in hay-making. Some general remarks on the grasses, will have to serve our purpose.

Timothy.—This is sometimes called "cat's tail," and in some of the Northern States, "Herd's grass." It is a perennial, and makes hay of fine quality, when cut in the proper season; and where the soil suits it, the crop is generally abundant. This grass, on account of the bulbous character of its roots, which are very near the surface, will not stand the climate of the South, except in favored localities.

Orchard Grass.—This grass will grow upon almost any soil which is not swampy. It may be sown in spring, with clover, which it eradicates after one or two seasons. It has a very strong root, and is not easily overcome by other grasses; it is, hence, suitable for lots designed to be kept in grass a long time. It starts early in spring, and continues green quite late in autum, and is, therefore, valuable for early and late pastures. *As a hay crop*, it does not hold a high place. When harvested for hay, it should be cut in full bloom; because the hay has then the highest value.

Herd's Grass.—Sometimes called "red top," thrives well in situations suited for it, which can hardly be too wet. It will succeed even on white, pipe clay land. It does not compare with other grasses as a pasture, but makes excellent hay.

Irish Velvet Grass.—"Irish velvet," is the name by which this grass is known in the middle part of Mississippi. It is sometimes called "*white top.*" It will grow on almost any land; and on soil of good quality and moderately moist, will grow to the height of two and a half to three and a half feet. Like clover, it is a biennial; but by plowing a crop under every third year, will keep possession of the land for several years. This is a soft, velvety grass, and would make excellent hay, if cut just when shedding its flowers. For pastures, there is no grass superior to it, as it remains green the whole winter in the latitude of middle Mississippi.

Lespedeza Striata.—This grass, or wild clover, comes up very early in the spring (latter part of February), from seeds matured the previous year—all the old plants die with the first heavy frosts of winter. Being a summer plant, it would grow almost anywhere in the South; we have heard of its taking foothold from Mississippi to Virginia. Stock will eat, but do not seem to be especially fond of it,—will generally eat grass in preference, where the two are side by side. It is a very hardy plant throughout the South; grows well under pines, in old fields, and upon very poor land, contending very successfully with the Bermuda and broom-sedge; stands drought well, and springs up again very rapidly after rain. In rich lands and in bottoms, when not grazed, it grows high enough to be cut for hay, and is said to make a very good article. The value of this plant will be found, we think, in its taking possession of old, worn out land, and restoring, more or less, its fertility. It has none of the character of a "*pest*,"—can be eradicated whenever desired.—*Southern Cultivator, April, 1869.*

PASTURES.

The proper care of pasture lands, is too much overlooked by many farmers at the South. Worthless briars and weeds often occupy the very best land, where a little timely care and attention would have secured a rich, green sod of sweet and nutritious grass.

In those sections of country where the perennial grasses will not thrive, more attention should be given to the introduction of *annuals* and *biennials*, to be cut for hay. The annual meadow-grass, the crop-grass, and *biennial* rye-grass, have been cultivated where those of a more permanent character will not take root. The different varieties of *millet*, *oats* cut in full bloom, and corn sown broad-cast, all make good substitutes for hay.

EXPERIMENTS.

Every farmer should make repeated experiments on his own lands, with various kinds of grass, that he may determine which are best adapted to his soil. Then it should be an established *rule:*

1. *Never to allow a field to be out of clover*, or some kind of grass, when it is not occupied by other crops.

2. Never to miss an opportunity of *plowing* under clover, or grass sod. It is the cheapest way of enriching the soil.

CHAPTER XVI.

THE TOBACCO CROP.

The following account of this subject is the result of the writer's personal experience and observation on the best methods pursued by some of the most successful planters in Virginia, North Carolina and Kentucky.

CLIMATE.

Tobacco requires a long summer season to bring it to maturity. Hence, so far as our own country is concerned, the *best* tobacco can be cultivated only in the Southern States. *Elevation* has an influence somewhat similar to increase of latitude. This makes the cultivation of tobacco uncertain in the high and mountainous parts of Western Virginia; while the like risk is not felt in the same latitude further east, where the elevation is not so great.

A variety, called the "Connecticut seed leaf," is cultivated with great success in the New England States, and at present commands a good price. It requires a shorter season than the kinds cultivated farther South.

SOIL.

Tobacco will grow upon almost any good soil, when well prepared by thorough tillage, but the best adapted to its culture is a rich, dry loam, new cleared and brought into cultivation. Although the light clay and sand loams, well manured, are the most reliable for making the finest qualities of tobacco, yet the clay soils produce excellent crops, but require free applications of rich organic manures to render them sufficiently porous. The sandy loam, which has been drifted down the mountain gorges of the Blue Ridge, is the best adapted to the growth of tobacco. The stiff clay lands of the Valley of Virginia and of Kentucky produce a large leaf, strong shipping tobacco. The same may be said of the deep loams of Missouri, Illinois and Indiana.

VARIETIES.

"Owing to the great diversity of climate and soil in Virginia, a corresponding change is produced in the grades of tobacco raised throughout the State, yet she produces more valuable tobacco than any other State in or out of the Union." The Orinoco and the Prior, for manufacturing, and the white stem, and big Frederick for shipping, are the most profitable to the planter, of all the various kinds raised. Having had twenty years' experience in cultivating and manufacturing, and the last five years in selling the article, I am clearly of the opinion that, on all lands suitable, the Orinoco is decidedly the best for manufacturing, from the fact that it is the only kind sweet by nature, if ripe. It should be sun-cured, or as much so as the season and circumstances will admit. If thoroughly ripe, it is much easier to be cured of the right color, and it stands manufacturing better. If cut before being ripe, it chews bitter, its color is forced, and it will not hold it.

The Prior is a good kind to cultivate on mountainous lands, as it stands the wind better than any other kind, being tough. For shipping purposes, I give the preference to the "White Stem." It can be grown large, and rich, is smooth, and tough when cured, and loses less in weight in curing than any other kind."—*W. H. Brown, So. Planter, Jan. 1859.*

PLANT BEDS.

The climate, the soil, and variety to be cultivated being favorably determined, the first, and most important thing to be done, *is to secure an abundance of plants.* To do this, the planter must look well to the preparation of his plant-beds. Of these he should have several, sown at different times, or one large one, divided into several parts, to be sown at different times. To meet all contingencies that may arise, and still secure an abundance of plants, enough ground should be sown to produce (if all portions do well) a large excess over what the crop to be raised will require.

PREPARATION OF BEDS.

The general practice is to burn the surface of the beds before planting. A warm and dry locality, exposed to the sun, and well protected against cold winds, is most suitable. A southern, or southeastern exposure, should be selected, if possible, having a loose, rich soil. It should be cleared of all roots, stones, and everything that might interfere with a proper tillage of the surface, or with the growth of the plants.

The burning process is then conducted by covering the bed, with logs and brush previously collected, entirely, or in part, and setting fire to them, at a time when they are dry enough to burn freely. The fuel should not be allowed to lie flat on the ground while burning, but should be placed upon cross logs, beneath it. The whole bed need not be covered with fuel at one time; because, when one portion has been subjected to the fire for an hour or two, the burning fuel may be removed to another portion, and thus the several parts be burnt in succession.* Some important effects are produced by the wasting process. In the first place, any seeds of grass, etc., which may be in the soil, are partially or entirely destroyed; and, secondly, the condition of the soil is improved by burning, and by the quantity of ashes left upon it. Beds should generally be burnt just before they are sown; though, in some soils, it is better to burn and expose to frost a few weeks before planting.

SOWING THE SEED.

As soon as the surface of the bed is cool enough, after burning, *guano*, or some finely pulverized manure, rich in *ammonia*, and *clear* from *seeds* of *every kind*, should be freely applied, and the surface finely chopped over with the hoe, and smoothly raked. It will then be ready for the seed. About two tablespoonfuls of seed for every one hundred square yards will be sufficient, and not too much. The seed are mixed with old ashes, and, to sow them regularly, it is best to sow one-half over the bed, and the other half *across* the first sowing It is then well trodden, and thickly covered with brush.

The object of the covering is to protect the young and tender plants against frost and sudden changes of weather, and, at the same time, to admit the air and light, and heat of the sun. The covering is removed when there is no longer danger from frost. One bed should be sown in winter, and the others early in the spring, to multiply the chances for an early supply of plants.

The fly is the great enemy of plant-beds. Various remedies have been tried for this evil. No remedy has been found better than the frequent application of *guano* and plaster, during the growth of the young plants, which has the effect of pushing them forward, so that they spring up rapidly, in spite of the fly.

All weeds and grass should be pulled out of plant-beds as soon as they appear.

PREPARATION OF SOIL FOR TOBACCO.

This is a point of the very first importance in making a crop of tobacco. The soil *must be rich and mellow*. *New land* is generally best for tobacco. But in the best tobacco-growing sections, the land is nearly all cleared, except so much as is required to be kept in timber for fencing and fuel.

The preparation of the *old land* is, therefore, the matter of importance. Tobacco requires an abundant supply of ammonia, as well as mineral matter, especially lime and potash. Hence, guano and rich stable and hog-pen manures, lime, plaster, and the phosphates, are all valuable fertilizers for this crop. It has been shown that *ammonia* is not generally abundant in soils which have been frequently cultivated without manures; hence, old lands require an application of some form of *ammonia*-producing manure to secure a good crop of tobacco.

A good clover or pea crop may be plowed down in the fall, and manured well and plowed again in the spring, with subsoiling, when the land requires it. If the manure is not abundant, some guano should be mixed with it, and a small quantity will then answer the purpose. All *wet* lands must be *well drained* for tobacco.

When artificial fertilizers are applied to this crop, they should be sown as soon as we begin to bed up the land to plant. Lay off the tobacco field as if to sow wheat, and sow guano, plaster, and salt, at the rate of two hundred pounds of Peruvian guano, one hundred pounds of phosphate of lime, one hundred pounds of plaster, and one hundred pounds of salt per acre. This application, upon fair land, will produce from one thousand to twelve hundred pounds of good tobacco to the acre. The manipulated manure should be sown just before the plows which are bedding up to the land, so that all can be bedded in every day, or the ammonia of the guano may escape.

The beds, or rows, should be from three and a half to four feet apart, according to the character of the land, and the plants set three feet apart in the row. This will give about four thousand five hundred plants to the acre.

PLANTING.

The season for planting in Virginia, is from the 15th of May to the 25th of June, and even as late as the 4th of July. A careful hand should draw the plants from the bed, which can be done with the hand alone, as it is very important to guard against bruising either the top or the roots of the young plant.

Some of the weaker hands take the plants in baskets, and following those engaged in flattening the hills or beds, drop a plant to each hill, while others follow with sharpened pegs, with which they make holes in the center of the hills to receive the roots. Care should be taken to have the root extend straight downward in the hole, and not doubled back upon itself; it is then more certain to grow. After the root has been inserted in the hill, the soil is pressed firmly around it. Of course, setting out plants can only be done when there is a good *season* in the land.

CULTURE.

The two leading objects to be kept in view in the culture of tobacco, are the same as those mentioned in the culture of corn, viz.: first, *all weeds and grass must be kept down;* second, the ground *must be kept mellow and well aired.* The culture should commence as soon after planting as possible, and kept up constantly until the plants are too large for its continuance. Within a week or two after planting, the soil on the surface of the hills may become crusted, and grass and weeds begin to make their first appearance. In either case, the hoes should be used, to scrape down the surface of the hills. A clean, loose suface will thus be formed around the plant. This should be followed by a deep plowing, which should be made so close to the hills as to cut down a considerable portion of the ridge, the dirt being thrown from the plant to the middle of the row. By a subsequent plowing, the soil (as soon as possible), should be thrown up again to the plants, and the hills dressed up with the hoes. By all the other plowings the soil should be thrown to the plant, and the ground kept loose and mellow until the plant becomes too large to work with a plow.

PRIMING AND TOPPING.

When the plant has grown to the height of two or three feet a round bud or "button" will make its appearance in the center of the plant. This is the *flower bud.* At this period some of the lower leaves must be pulled off, so as to leave the stalk naked for five or six inches above the ground. This is called "priming." At the same time the priming is done, the flower bud is nipped with the thumb and finger. If a plant is large enough, it may be topped before the "button" makes its appearance by nipping out the leaf bud. There is a great difference of opinion as to the proper height of topping. From eight to twenty leaves are recommended—the latter for manufacturing. If the tobacco is pretty forward, and the land rich at first, prime off just enough leaves to hill up the tobacco well, and top to twelve or fourteen leaves. Continue to top to twelve leaves until the 1st of August, then top to ten leaves until the middle of August, and from that time until the 1st of September top to eight, and afterwards to six. Soon after the topping and priming is done, then comes the "suckering" and "worming;" the buds at the base of the leaves begin to grow rapidly, if left alone, would form branches of the main stalk. They are called "suckers," and must be broken out as soon as they are large enough to be caught with the thumb and forefinger. This process is repeated from time to time, as the new suckers make their appearance. Meantime the tobacco or green worm will have commenced its ravages, and must be carefully picked off and destroyed, otherwise it will greatly disfigure and greatly injure the crop. The *philosophy* of priming, topping and suckering is easily understood. All parts of the plant are designed to aid and mature its growth for the production of seed. As the period approaches for maturing the seeds, nearly all the vital energy seems to be directed toward and expended upon them. If the "button" is removed all the vigor of the plant is thrown into the leaves and suckers, and the suckers being removed, the vigor of the plant is concentrated in the remaining leaves. By priming the air is admitted to the middle leaves of the plant, and at the same time the plant can be hilled up to better advantage.

CUTTING.

The maturity of the plant, and consequent fitness for cutting, is indicated by the points and edges of the leaves curling downward, the leaf becoming *thick and brittle*, and its surface assuming a yellowish, spotted appearance. At this stage the plants contain more of the ingredients which afterward give value to them than at any other period, either earlier or later. It should *then be cut*, and not till then, unless it is *becoming fired*, or there is immediate danger of frost. The cutting consists in splitting the stalk with a sharp, thin-bladed knife, down nearly to the lowest leaf, and then cutting it off below this leaf. As the plants are cut they are inserted between the hills, and allowed to remain in that position a few hours, until they are sufficiently wilted to be handled without being broken. They are then collected and placed (eight or ten) together upon sticks, and hung on scaffolds in the open air, or upon the tier poles in the tobacco barn.

CURING.

The process of curing, is a matter of the highest importance. On it depends, to a great extent, the market value of the crop. It should, therefore, be attended to with great care. The modes adopted vary somewhat with the end for which the crop is designed.

Tobacco, for manufacturing purposes, should be exposed to the air on scaffolds; and, if ripe and *sun cured*, it will have that sweet aromatic flavor so peculiar to good tobacco. After cutting, it should be carried to the scaffolds and hung (without touching the ground) about eight plants on a stick, and closed on the poles for the purpose of sweating; by this process the green color is expelled, and the tobacco becomes *yellow*. It should then be removed to the barn, and be fully cured by fire, either of *charcoal* or flues.

For "shipping purposes," the tobacco may be hauled to the barn as soon as wilted, and the process of curing commenced immediately, while the plant is still green; this gives the tobacco a dark, rich color, so popular in the English and German markets. The sticks may be placed about six inches apart in the barn, and a little closer in the roof than in the body of the barn.

THE CHEMISTRY OF CURING.

During the process of curing, tobacco undergoes important chemical changes. Its peculiar properties are, owing to the presence of several remarkable compounds, of which one is called "nicotine," another "nicotinanine," these are the most important. "*Nicotine*" is an alkaline substance, and has the form of an oily liquid, when separated from the other compounds. In its concentrated form, it is a deadly poison. The quantity of nicotine varies in the different qualities of tobacco cultivated in the same region, and still more does it vary in that cultivated in different countries. The Havana has about two per cent. of nicotine, hence its mildness. Virginia (best manufacturing) tobacco, has five or six per cent., while the stronger "shipping varieties" have about seven per cent. *Nicotianine*, is a more volatile substance than nicotine, and is more odoriferous. The pleasant odor of good tobacco is due chiefly to this compound. The *nicotianine* and *nicotine* do not exist in the green leaf, but are formed during the curing of the tobacco, from substances already in the plant. If the leaves are dried very rapidly, these compounds are not fully formed; and if the heat is raised too high in firing, they may disappear to some extent. Hence, the firing should be commenced at a low temperature, which can be gradually increased, and may be advantageously suspended at night. The temperature should never rise above one hundred and thirty degrees. Curing yellow tobacco with charcoal, a high temperature kept up day and night, is recommended, say, one hundred and fifty to one hundred and sixty degrees.

It is best to "fire" all grades of *shipping tobacco*, and to cure it a dark *nutmeg color*. From twenty-four to thirty-six hours after cutting, if the tobacco is ripe—if not, thirty-six to forty-eight hours, according to the weather—seems about the right time to commence firing. Begin with small fires, and bring the tobacco to a proper state, and then increase the fires.

SHIPPING, HANDLING, ETC.

After the tobacco has been fully cured, the next step is to strip the leaves from the stalks, and tie them up in little bundles (hands), to be pressed (prized) into hogsheads for market. The two points to be attended to in shipping are, first, to have the tobacco in proper "order;" and, secondly, to *assort carefully*, so as to separate the different qualities. Tobacco is in "order," when the leaf is sufficiently moist to be pliant, and yet the *stem* dry enough to break off readily from the stalks. This condition can be secured only in the beginning of a spell of damp weather. After the weather has continued damp for some little time, the moisture penetrates the stems, as well as the thinner part of the leaves, making them too tough to be easily broken from the stalks, and rendering them liable to mould when wrapped together, or when the tobacco is laid down "*in bulk*." If the stems have thus become pliant, the tobacco is in "too high order," and must be thoroughly dried, and allowed to come in order again, before the stripping can be done. A large quantity may be kept in order for stripping, by packing down when in proper condition, upon an elevated platform extending along one side of the barn. This is called "bulking." The leaves of the plants must be lapped over each other in the middle of the bulk, the but-end of the stalks being turned outward. The whole mass must then be covered with straw or leaves, which will preserve it in *order*, until it can be conveniently stripped, which is generally at times when the weather is unfavorable for out-door work.

The business of *assorting*, requires both care and judgment. It should, therefore, be the business of the most experienced and trustworthy hands. It is accomplished chiefly during the process of stripping, but may be made more complete, by the hands engaged in tying, attending to the sorting out of such leaves as do not properly belong to *grades* upon which they are engaged. The number of "grades," or qualities, must be determined by the purpose for which the crop is designed. Where the object is to make the dark *shipping tobacco*, the best leaves are assorted, according to size and quality, into *first* and second *quality* "*leaf*;" while the lower leaves, together with others that may be injured or ragged, form first and second quality of "*lugs*."

If the crop is designed for the manufacturer, the *color*, as well as the quality, must be taken into account. The *dark* and yellow colors, must be first separated into two general classes, and each of these again assorted, according to their several qualities. So, we would have five classes: *Yellow*, *good yellow*, *dark*, *good dark*, and "*lugs*." When the assorting and tying have been completed, the bundles should be "bulked down," unless the stems are found to contain so much moisture as to be in danger of moulding. It should then be hung up on sticks, and thoroughly dried. Then, at the first favorable time before prizing, it should be again bulked down. The bundles should be carefully straightened in packing down; and, when it is afterward transferred to hogsheads, the same, or still greater care should be taken, that every leaf be straight, and in its proper place. The hogsheads usually contain about thirteen or fourteen hundred pounds.

The price of tobacco depends very much upon the *skill with which it has been cured*, and *the care bestowed upon the assorting*, tying, and subsequent handling.

CHAPTER XVII.

CULTIVATION OF CUBA TOBACCO.

The soil for the Cuba tobacco ought to be of a rich sandy loam, neither too high nor too low—that is, ground capable of retaining moisture. The more level, the better, and, if possible, well protected by margins. For raising plants, preparing and cultivating the land, a similar process may be adopted as that described in the preceding chapter for the common tobacco crop of this country. When the plants have acquired twelve or fourteen leaves, and are about knee high, we should begin to top them, by nipping off the bud, with the aid of the fingers and thumb-nails, taking care not to destroy the small leaves immediately near the bud; for, if the land is good and the season favorable, those very small top leaves will, in a short time, be nearly as large, and ripen quite as soon as the lower ones, whereby two or four more leaves may be saved, thus obtaining from sixteen to eighteen leaves, in the place of twelve or fourteen, which is the general average.

The topping of the tobacco plant is absolutely essential in order to promote the growth and to equalize the ripening of the leaves; it should be commenced the instant the bud of the plant shows a disposition to go to seed, and be immediately followed by removing the suckers which it will now put out at every leaf. *The suckers must be kept down.*

The Cuba tobacco plant ought never to be cut before it comes to full maturity, which is known by the leaves becoming mottled, coarse, of a thick texture and gummy to the touch, at which time the end of the leaf, by being doubled, will break short. It ought not to be cut just after a rain, as the leaves have then lost their gummy feel; in a day or two the gum will again coat the surface of the leaf.

About this period the cultivator is apt to be rendered anxious by the fear of allowing the plants to remain too long in the field. He should be on his guard, not to destroy the quality of his tobacco by cutting it too soon. When the cutting is to commence, there should be procured a quantity of forked stakes, set upright, with a pole, or rider, sitting on each fork, ready to support the tobacco and keep it from the ground.

The plant is then cut obliquely, even with the surface of the ground; then, after tying two stalks together, they are gently placed across the riders or poles prepared to receive them. In this state they are allowed to remain in the sun or open air until the leaves are somewhat wilted. Then place as many plants on each pole as can be conveniently carried, and take them to the drying house, where the tobacco is strung off on frames prepared to receive it, leaving a small space between the two plants, that air may circulate freely among them and promote their drying. As the drying advances, the stalks are brought closer to each other, to make room for those which remain to be housed.

In drying the tobacco, all damp air should be excluded, nor should the drying be hastened by the admission of high, drying winds. This process is to be promoted in the most moderate manner, except in rainy seasons, when the sooner the drying is effected the better; for it is a plant easily affected by the changes of the weather, after the drying commences. It is liable to *mildew* in damp weather; that is, when the leaf changes from its original color to a pale yellow cast, and from this, by parts, to an even *brown*.

When the middle stem is perfectly dry, it can be taken down, and the leaves stripped from the stalk and put in bulk to sweat; that is, to make tobacco of them. The leaves are to be stripped from the stalk in damp or cloudy weather, when they are more easily handled and the separation of the different qualities rendered more easy. The *good* leaves are kept to themselves, for "*wrappers*," and the most defective ones for "fillings."

When the tobacco is put in bulk, the stems of the leaves should all be kept in one direction, to facilitate the tying of them in "*hanks*," afterward making the bulk two or three feet high and of proportionate width. To guard against the leaves becoming overheated, and to equalize the fermentation or "sweating," after the first twenty-four hours put the outside leaves in the center, and those in the center to the outside of the bulk. By doing this once or twice, and taking care to cover the bulk with sheets or blankets, so as to exclude all air from it, and leaving it in that state forty days, the tobacco acquires an odor strong enough to produce *sneezing*, and the other qualities of cured leaf. The process of curing may then be considered as completed.

Then take some of the most injured leaves, but of the best quality, and in proportion to the quantity of tobacco made, and place them in clear water; there let them remain until they rot, which they will do in about eight days. Next, break open your bulks, spread the tobacco with the stems in one direction, and dampen it with this water, in a gentle manner, in order that it may not soak through the leaf, for, in that case, the leaf would rot. A sponge is used in Cuba for this delicate operation. Then tie the hanks of from twenty-five to thirty leaves.

This being done, spread the hanks in the tobacco house for about twelve hours to air, in order that the dampness may be removed, and afterward pack them in casks or barrels, and head them tight, until you wish to mauufacture them. The object in dampening the tobacco with this water is to give it elasticity, to promote its burning free, to increase its fragrance, to give it an aromatic smell, and to keep it always soft. This is the *great secret* of curing *tobacco for cigars*, as practiced in Cuba.

We have here (St. Augustine, Florida) three cuttings from the original plant. The last will be of rather weak quality, but which will be agreeable to those who confine their smoking to weak tobacco. In the "ratooning" of the plant, only one sprout ought to be left; all the other sprouts should be broken off and destroyed.

The houses necessary for curing this tobacco ought to be roomy, with a passage-way running through the center, from one extremity of the building to the other, and pierced on both sides with a sufficient number of doors and windows to make them perfectly airy.

In order to obtain vigorous plants, the seed ought to be procured from the original stalk, and not from the "ratoons," by allowing some of them to go to seed for the express purpose. Every three or four years we should send to Cuba for fresh seed.—[*Joseph M. Hernadez, St. Augustine, Florida.*

CHAPTER XVIII.

THE POTATO CROP.

The Irish, or common potato, will grow upon almost any soil, with good management and a favorable season; but a loose, moist, and cool soil, is most suitable. Well-drained swamps often produce the potato with great luxuriance. North-lying slopes, of loose, rich mould, gravelly, and sandy loams, are all favorable to the production of this important crop.

PREPARATION.

The ground should be prepared by a thorough plowing in the autumn or winter. In the spring, at the time selected for planting, manure should be applied, either immediately, or before planting, or in the drill with the potatoes. If manure is not abundant, it is more economical to use it in the drill for covering the potatoes at the time of planting.

MANURES.

The best manure for potatoes is fresh stable, or hog-pen scrapings, mixed with a large portion of broken straw, leaves, or other litter. From ten to twenty wagon loads per acre, as the soil is more or less fertile, should be applied, in case it is spread on the surface. A smaller quantity will be sufficient, if applied in the drill. When only a small quantity of this kind of manure can be collected, a little Peruvian guano may be mixed with it (one hundred pounds), very much to the advantage of the crop. Cotton seed is one of the best manures for this crop.

PLANTING.

In our Southern climate, the great enemy of the potato crop, is the hot sun, and, particularly, if accompanied by drought. Our planting should, therefore, have special reference to protection against heat and drought. The best means of accomplishing this is *mulching.* After preparing the ground, and planting the potatoes in the best manner, the whole surface should be covered to the depth of eight or ten inches, with broken straw, forest leaves, or some other litter. This covering (mulching) protects the ground against the severe heat of the sun, prevents rapid evaporation, and secures both a cool and moist soil. Besides this, it prevents the growth of weeds, while the potato vines rapidly find their way to the surface. This plan will require no after culture, except to pull up a few weeds which may get through the *mulching.*

CULTURE.

If the method of planting is adopted which requires future culture, all plowing and hoeing should be done in the early stage of growth. No working which will disturb the roots, should be done after the flower-buds begin to make their appearance.

If weeds still prove troublesome, they may be removed by shallow hoeing, or by hand. Deep covering at time of planting, or heavy earthing in future culture, are injurious to the crop, especially in heavy clay soils, or in damp localities.

The flower-buds of the potato should be plucked off as soon as they make their appearance. The nutrition, expended in the production of seeds, is almost identical in kind, with that which promotes the growth of the potato. Hence, if seeds are produced, it must be at the expense of food, which would otherwise nourish the tubers.

DIGGING.

As soon as the tops of the potato die, it indicates full maturity of the tubers, and the crop should then be gathered. For if the weather is warm and moist, there is danger of second growth, which makes the potato watery. After being dug, they should be dried in the open air, and laid away in the earth; a dry, elevated spot should be selected for this purpose, and so prepared that the water cannot collect in the bottom of the bed. They should not be buried until near the beginning of winter, as there will then be little danger of heating, and consequent rotting, under the influence of warm weather.

Before the weather becomes warm enough in the spring for the sprouting of the tubers to commence, they should be taken up, and returned to the cool, dry cellar. If they are damp when taken from the ground, they should be spread out in the sunshine for a few hours. They may be kept in good condition for eating much longer, by being spread on a dry floor, in a cool situation, than in any other way—the great object being to prevent *germination.*

SELECTIONS FOR PLANTING.

Those designed for seed may be conveniently selected, either at the time the crop is laid up in the fall, or when spread out in the spring. For planting, tubers of *medium size* are best, because their *buds* (eyes) are generally more vigorous than those very large or very small. The object of planting this, as well as other crops, should be to secure plants which are healthy and vigorous at the beginning of their growth. For early planting, the "Goodrich" and "Early Rose" are esteemed the best. For late planting, the "Long John" and "Long Red" are probably the best, for the Southern States.

DEGENERATING.

Potatoes are found to degenerate in the hands of many farmers, and hence an impression prevails extensively, that the same variety *naturally runs out*, when cultivated in the same soil and climate, for several successive years. This is true, to some extent, if it is planted too frequently on the same land, even when the best modes of culture are pursued. It is also true, when the little, worthless potatoes are selected for seed year after year. Corn, wheat, rye, and every other kind of crop, degenerates under similar treatment.

Let the farmer try the plans above given *carefully*, for a few years in succession, and it is most probable that he will find the quality of his crop *advancing* gradually, instead of retrograding. Such, at least, has been the writer's experience, in the cultivation of this important crop.

THE SWEET POTATO.

The Carolina or sweet potato, to the successful cultivation of which the climate and soil of the South is so admirably adapted, yielding, as it does, from one hundred to four hundred bushels to the acre, at comparatively litte cost, and being so highly nutritious to man and beast, claim for it the first place among the crops we should cultivate. The intelligent and prudent farmer, anticipating the shortness of the corn crop cousequent upon droughts or other adverse circumstances, will readily turn his attention also to this crop, and others, which like it, come to maturity at a different time. For this crop, sandy land having a good clay subsoil, is to be preferred. The red and the yam potato are in the highest esteem. As soon as the frost is out of the ground in the spring, the potatoes should be bedded out to obtain slips; the earlier this is done the better, as it is very important to an abundant supply of slips at the first planting.

PREPARATION OF LAND FOR PLANTING.

Lay off rows three and a half to four feet apart, deepen the furrows with the turn plow, throwing out each way, followed by a bulltongue or coulter, running deep. Place in the trench thus formed half rotted straw or leaves, or any rough compost, and in stiff lands, corn cobs and the rakings of the wood yard—the larger the chips the better. This is to loosen the soil and make room for air, which, like moisture, is highly essential to the growth of this tuber. If the soil needs manure, it can be applied at this time, in some concentrated form, fifty pounds of Peruvian guano and fifty pounds of bone dust would increase the crop very materially. Then bed up in the usual way ; just before planting the slips the beds should be "flushed up." If your plants in the bed are large enough, the best time to set them out is just before a rain. If this cannot be done set them out when there is a good season in the ground. About two or three thorough workings will make the crop. After the vines commence running, they very often take root between the rows; they must be loosed from the soil, otherwise numerous tubers will be formed in every direction, much to the injury of the main crop.

Sweet potatoes should be dug before they become chilled by the *frosts*. They should not be allowed to remain long in the sunshine, but be deposited as soon as it can be made convenient, where they are to remain, and covered with straw, corn stalks or other dry litter. Earth may now be leisurely thrown on in such way and in such quantity as to prevent the ingress of water. A hole must be made and kept open at the top, which should be sheltered by bark or a piece of board. Another method of banking which has been tried for a long series of years, and found very successful, is as follows: Dig a ditch of convenient length, two feet deep, and three feet wide on high and dry ground, lay in a thick bed of straw for bottom and sides, fill the ditch heaping with potatoes, cover with straw, and then with earth, leaving air holes at top, at intervals of three feet. Upon a ridge-pole placed upon forks, and nearly touching the top of the bank, make a shelter of clap-boards, which may be confined down by billets of wood.

TURNIP CROP.

The cultivation of the turnip as an esculent, both for animals and man, is of great antiquity, and it is too much neglected at the South.

Selection and Preparation of the Soil.—Turnips delight in a loose soil, on new land, in which they are raised to the greatest perfection, and the least risk. It has been proved by long experience, in this country, that old sod, well rotted, or newly cleared land recently burnt over, produces the largest and best flavored roots. These four points should be carefully attended to in the cultivation of turnips: First—To have the ground in a finely pluverized state. Second—To force forward the young plants into the rough leaf, in order to secure them from the attack of the fly. This is best effected by sowing guano, superphosphate of lime or other stimulating manure with the seed. Third—To have the ground clean and free from weeds before the seed are sown, and watching the growth of weeds afterward, and cutting them off before they choke the crop. Fourth—If sown in drills, to keep the ground constantly loose and open about the plants by stirring it between them in dry weather.

Choice of Seed.—New seed should always be sown in preference to old.

Quantity of Seed.—The quantity of seed varies according to the condition of the soil and kind employed. Say from one to four pounds to the acre.

Uses.—Food for man and beast.

CHAPTER XIX.

SORGHUM CANES.

The soil and geographical range of the Chinese sugar cane, corresponds nearly with that of Indian corn, and it thrives with great luxuriance in rich, bottom lands, or in moist, loamy soils, well manured. It will produce a fine crop on dry sandy, or gravely soils, too poor to give good crops of other plants. On the latter class of soils, however, it has proved more profitable to the cultivator, where there had been applied a moderate quantity of guano, superphosphate of lime, and plaster. Say, fifty pounds of Peruvian guano, fifty pounds of superphosphate, and one hundred pounds of plaster.

This plant endures cold much better than corn, and, resists without injury, slight frosts in the fall. It will also stand excessive drought. In Virginia, and other Southern States, it will ripen its seeds in October, when planted by the 20th of June. At the extreme South, it may be planted from January to July.

The cost of culture of this plant, does not differ essentialy from that of Indian corn. The seeds require to be planted at different distances apart, according to the strength of the soil. On light, moderately rich land, it succeeds best when sown in rows or drills, three feet apart, with the plants a foot assunder in the drill; but on rich land, it has been found preférable to have the drills four or five feet assunder. If cultivated exclusively for fodder, and to be cut green for stock, the seed may be sown broadcast, and treated in the same manner as Indian corn, when grown for that use.

The height of the plant varies from six to eighteen feet, according to the locality and the condition of the soil; the stalks ranging from half an inch to two inches in diameter. The weight of an entire crop to an acre, when green, varies from ten to forty tons. The amount of seed will range from fifteen to sixty bushels to the acre.

During the earlier stages of the growth of this plant, say for the first six or eight weeks, it makes but little progress, except in penetrating the ground with its roots; it then grows off very rapidly. The period of its growth, varies from ninety to one hundred and twenty days; the seeds often ripen unequally in the same field.

The yield of juice from well trimmed stalks, is about fifty per cent. The number of gallons of juice required to make a gallon of syrup, varies from five to ten, according to the locality, the nature of the soil, and the condition and the maturity of the canes. The yield of syrup per acre, is from one hundred to four hundred gallons. The amount of pure alcohol procured from the juice, ranged from five to nine per cent. In cases where the plant is well matured, and grown upon warm, light soil, the juice will yield from thirteen to sixteen per cent. of dry, *sacharine* matter; from nine to eleven per cent. of which will be well-defined, crystalized cane-sugar.

A very palatable bread may be made from the flour ground from the seeds of this plant. By accounts from all parts of the country, this plant is universally admitted to be a *wholesome*, nutritious, and economical food for animals; all parts of it being greedily devoured in the green or dried state, by horses, cattle, sheep, poultry and swine, without injurious effects; the two latter, fattening upon the seed, equally as well as upon corn.

MANUFACTURE OF SUGAR AND SYRUP FROM THE JUICE.

In the first place, it is necessary to filter the juice of the plant, *as it comes from the mill*, in order to remove the fibrous matter and starch, which are present in it when pressed out. A bag filter, or one made of a blanket, placed in a basket, will answer this purpose. Next, we have to add a sufficiency of the *milk of lime* (that is, lime slacked and mixed with water) to the juice, to render it slightly alkaline, as shown by changing *tumeric* paper to a brown color, or reddened litmus paper to a *blue*. A small excess of lime is not injurious. After this addition, the juice should be boiled, say, for fifteen minutes. A thick, greenish scum rapidly collects on the surface, which is removed by a skimmer, and then the liquid should again be filtered. It will now be of a pale, straw color, and ready for evaporation. It may now be boiled down rapidly, to about half its original bulk, after which the fire must be kept low, the evaporation to be carried on with *great caution*, and the syrup constantly stirred, to prevent its burning at the bottom of the kettle or evaporating pan. Portions of the syrup is to be taken out from time to time, and allowed to cool, to see if it is dense enough to crystalize. It should be as dense as sugar-house molasses or tar. When the syrup has reached this condition, it may be withdrawn from the evaporating vessel, and be placed in tubs or pans, to granulate. Crystals of sugar will begin to form, in from three to four days, and sometimes nearly the whole mass will granulate, leaving but little molasses to be drained. After it has become solid, it may be scooped out into conical shaped bags, made of coarse, open cloth, or canvas, which are to be hung over the receivers for molasses; the drainage being aided by warmth, it will be useful to keep the temperature of the room at eighty or ninety degrees, Fahrenheit.

After some days, the sugar may be removed from the bags, and will be found to be good, brown sugar. If desired, it may now be refined, by dissolving in it hot water, adding to the solution the whites of eggs (say one egg for one hundred pounds of sugar), mixed with cold water, after which the temperature is to be raised to boiling, and the syrup should be allowed to remain at that heat for half an hour. Then skim and filter, to remove the congulated albumen, and the impurities it has extracted from the sugar. By means of bone-black, such as is prepared for sugar refiners, the sugar may be decolored, by adding an ounce to each gallon of the sacharine solution, and boiling the whole together. Then filter, and you will obtain a nearly colorless syrup. Evaporate this, as before directed, briskly to half its bulk, and then slowly, until dense enough to crystalize, leaving the syrup as before, in tubs or pans to granulate. This sugar will be of a light brown color, and may now be clayed and whitened by the usual method—that is, by putting it into cones and pouring a saturated solution of white sugar upon it, so as to displace the molasses, which will drop from the apex of the inverted cone. The sugar is now as refined as loaf sugar.

The methods here described are common and cheap ones, such as any farmer may employ. It may be advantageous, when operations of considerable extent are contemplated, to arrange a regular system of shallow, evaporating pans, for the concentration of the syrup. A very large proportion of our farmers will doubtless be satisfied with the production of good syrup from this plant. They may obtain it by following the method above described, or, they may omit the lime, and make an agreeable, but slightly *aciduous* syrup, that will be of a lighter color than that which has been limed. This syrup is not liable to crystalize, owing to the presence of acid matter. The unripe canes can be employed in making molasses and alcohol, but, as before stated, will not yield true c me-sugar.

SUGAR CANE—SACCHARINE OFFICINARUM.

The present condition of the West India Islands, and particularly the Island of Cuba, makes it interesting to look into the culture of the *true sugar cane*, and see if it cannot be cultivated profitably in higher latitudes than at present.

Louisiana took the lead in the cultivation of this plant; as early as 1726 it was cultivated near New Orleans, but sugar was not made in that State until the year 1760, and so late as the year 1818, the entire crop of the State amounted to only 25,000 hogsheads. The product of sugar in Louisiana in 1845 reached the enormous quantity of 207,337,000 pounds, and about 9,000,000 gallons of molasses, and nearly $15,000,000.

The cane was introduced into Georgia from Otaheite in 1805, and sugar was for some time produced for export. It was an object of attention while it commanded ten cents per pound, but when the prices declined to five or six cents, it ceased to be manufactured as an article of commerce, though still produced for domestic consumption. Of late years a good deal of attention has been paid to its cultivation in Texas and Florida. Large portions of these States are well adapted to the growth of the plant. The Southern and middle portions of Alabama and Mississippi, as well as the Eastern portions of the Carolinas, have grown the true sugar cane to some extent for syrup.

RIBBON CANE—CREOLE OR MALABAR CANE.

The introduction of the ribbon cane from Georgia into the adjoining States, in 1817, by giving a much hardier variety, has largely extended the area of its cultivation.

VARIETIES.

The kind most cultivated in the United States is the *stripped* ribbon or Java, which is by far the hardiest and most enduring cane. It grows rapidly, is of large size, and resists the effects of early and late frosts, and the excess of rains or droughts and disease, better than any other. It has, however, a hard course rind, and yields juice of only medium quality. The Creole, Crystaline or Malabar, was the first introduced, and though of diminutive size, is a cane of great richness and value. Several varieties of the Otaheita, the purple, the yellow, and the purple banded, are more or less cultivated, but the juice is decidedly inferior to the Creole.

SOIL.

The cane will flourish in a great variety of soils, varying between the extremes of stiff clay and a light, sandy loam, provided the clay soil be well drained and fertile. The soil best suited is a *rich loam*, well supplied with lime, and such as will yield the best crops of Indian corn. The best and most enduring soils in the West Indies and elsewhere, contain large quantities of lime and phosphates. One of the most profitable sugar plantations in Louisiana has a profusion of shells scattered over it in every stage of decomposition.

SEED CANE.

This plant is always propagated by cuttings. These ought to be provided from the best and most mature cane of the preceding season. The only available means of improving or preventing deterioration is to be found in planting the *very* best qualities of seed cane.

PRESERVATION OF SEED CANE.

This is kept from the period of cutting until planting, by simply placing it on the dry surface of the ground, in beds or mattresses, as they are technically called, of about ten feet in depth, and having the tops shingling, or overlying the ripe portions of the stalk to protect the seed cane from the frosts and sun. It is well to preserve an excess of seed cane, as continued and severe spring frosts may cut down and destroy so many young shoots as to leave a *bad stand*, unless partially replanted. Many assert the cane will keep better by being cut soon after a rain, so as to be bedded with the sap vessels full, and that dry rot follows when cut after a drought. Some planters, however, allow it to lie on the ground and wilt for two or three days after cutting, and assert when thus treated, the cane keeps equally well. *Corn which is intended* for grinding is often thus secured when severe frosts are anticipated. It requires additional labor to top and trim it when thus harvested, but a good yield of sugar is in that way secured, which might otherwise be lost.

PREPARATION FOR PLANTING.

Where the land is fresh, it is invariably light, and full of vegetable matter. Shallow plowing, and wide distances between the rows, are then justified. The cane grows luxuriantly in such soils, and when there is a deficiency of warm weather to mature fully, room is required to allow a free circulation of air, and the full benefit of the sun, to ripen it before the approach of frost. From seven to ten feet is near enough for the rows, but these should contain from two to three continuous lines of good plant cane. Where the land is very fertile, wide rows, if well cultivated, will produce an equal quantity, as if planted closer, and there is much less expense and labor in planting and cultivating the crop.

Land that has been long in culiivation may be planted nearer, *but if rich*, as it ought always to be, the rows should never be nearer than six feet, and might, with advantage, extend to nine. It was formerly the practice to plant a single line of cane, in rows from two and a half to four feet apart; but this system has been abandoned, as it was found troublesome in cultivating, slower in ripening, and it is believed to have lessened the *size* of the cane.

Some planters make their cane beds every sixteen feet, planting in each, two rows of cane at a distance of four feet, and leaving a space between every alternate row of eleven feet. There is a great advantage in these wide spaces, as the *trash* (top, leaves, and vegetable matter), together with the *bagasse* (the residium of the cane after expressing the juice), can all be buried in the wide spaces, and remain undisturbed till decomposed, without injuring the growing crop. On light, sandy lands, these materials may be burned, and the *ashes* applied to the soil; but in adhesive, or clay soils, good husbandry requires that *all* should be buried, as the vegetable decay, the humus or mold, not only contains every element for the reproduction of the future crop, but it effects a mechanical division in the soil, of great value to its porosity and productiveness. If oyster shell lime, or any other lime, be added to the "bagasse" (refuse from the sugar mills), it will hasten the decomposition, and at the same time correct, or neutralize, the acetic acid, or vinegar, formed by the fermentation of the "bagasse" in the soil.

The land should be deeply broken up, with a two or *four* horse plow. If light and sandy, it may be plowed flat; but if stiff or wet, it should be thrown up in beds. Great advantage has generally followed the use of the *subsoil plow*, when run a foot below the bottom of the turning furrow, and immediately under the rows to be occupied by the seed-cane. This is the more important, as no opportunity will again occur for breaking up this portion of the soil, until the plant is renewed. The plowing should never long precede the planting, unless in stiff soils, which need the mellowing influence of the atmosphere to crumble the large clods; nor in these, beyond the period necessary to effect this object. A fine bed of well pulverized earth is thus secured for the plants *to root in*, and afford its nourishment to the young shoots.

PLANTING.

This may be done any time between October and April. There is a greater certainty of a good crop, if in the ground by the first of March.

On land previously well plowed, open a wide furrow, with the *fluke*, or double mold-board plow, clean this out with the hoe, of a uniform width, by the removal of any clods that may have fallen in after the plow. With the increased width of trench, now usually adopted by the best planters, not less than three parallel seed-stalks should be planted. These ought to be in line, and about four inches apart; and it is better to place them so that the eyes may shoot out horizontally, and thus come up at the same time, and on opposite sides of the seed-stalk. Cover with sufficient earth to prevent freezing, from any weather that may follow. On the approach of spring, remove the earth to the depth of one or two inches. Light spring frosts will not injure the plant, otherwise than to cut down the young shoots, and thus delay the growth till new leaves appear. The only danger is in removing too much of the earth, so as to expose the roots to freezing.

CULTIVATING.

Throughout most of Louisiana the cane yields three crops from one planting. The first season it is called *plant cane*, and, subsequently, *ratoons*. On new and very favorable lands the ratoons will produce equal to the plant cane for several years; and sometimes on the prairie lands of Attakapas and Opelousas, and in higher latitudes, it requires to be planted every year. The cultivation is alike in either case, after the young shoot makes its appearance, previous to which the ratoons should be *barred* off and *scraped*, on the approach of settled warm weather. The sun's influence is thus sooner felt upon the roots, and a quicker growth is secured to the cane. But if these operations are performed early, or too closely, frosts may seriously injure the plants. Soon after the plants have made their appearance, the earth is gradually thrown back to them by repeated plowings, the hoes aiding the operation, and to keep the cane clear of weeds. There is a great advantage in wide planting, as two-horse plows can be used in cultivation. There is generally a larger growth from deep and efficient plowing; and where weeds, and more especially the *coco grass*, abound, great economy in subduing these is secured by the use of the large plow, as they are thus so deeply buried, and can again only make their appearance after a long interval.

When the cane has acquired such a hight and expansion of leaves as to shade the ground effectually (which, if all the first operations have been well performed, will be about the first of June), the last furrows are thrown to the roots, and the earth slopes gradually to the center, forming an elevation about the plants and a depression between the rows (a water furrow), which serves as a drain for the surplus rains. Many of the best planters run a large subsoil plow in this water furrow, which more effectually drains the bed. Throughout the cultivation, except when first barred off, great care should be observed to avoid cutting or breaking the roots. This *caution* is applicable to *all plants*, but especially to the *sugar cane*, which requires the aid of all its roots to develop and mature the plant before cold weather. Good implements, good plowmen, and thorough tillage, are essential preliminaries to a good sugar crop.

HARVESTING.

In the West Indies and most other foreign countries, where this plant is grown, the cane fully ripens; but in Louisiana and other States, it very seldom or never fully matures. It begins to ripen at the foot of the stalk, in August or September, and advances upward at the rate of about six inches per week. The proper period for cutting would be just previous to the heavy black *frosts*, or freeze; but as it requires several weeks to secure the crop, the harvesting is generally commenced by the middle of October, and steadily followed up till completed. This is done by striking off the top (unripened part), then stripping the leaves by a single downward stroke of the knife on either side; and another blow severs one or stalks at the foot. The cane is then thrown upon carts and hauled to the mill, where it should at once be ground, the juice expressed, boiled, granulated, and put up for market.

Slight frosts in autumn are beneficial, rather than injurious, as, by deadening the leaves and tops, they check vegetation, and stimulate, rather than retard, the ripening of the plant. When severe frosts are apprehended, it will justify cutting the cane as rapidly as possible, and *mattressing*, as before described under the the head of "*the preservation of cane.*"

The mode of making sugar and molasses from the true cane, has been reduced to such a science that a description of the appliances and machinery necessary for the operation, would require a book larger than this MANUAL. It rather belongs to the arts than to agriculture.

ANALYSIS OF THE ASHES OF THE SUGAR CANE, BY STENHOUSE.

Silica	44.13
Phosphoric Acid	4.88
Sulphuric Acid	7.74
Lime	4.49
Magnesia	11.90
Potash	16.97
Soda	1.64
Chloride of Sodium (salt)	7.25

From the above analysis, we can see the mineral ingredients necessary to be returned to the soil. We can now intelligently discuss the

MANURES FOR CANES.

If the alluvial bottoms of Louisiana and other fertile, level lands, are properly managed, they will never become exhausted by the cultivation of cane. *Tired of it* they may be, as land is of any constantly recurring crop; but *exhaustion* will never be accomplished if the elements constituting the stalk and leaves of the plant are, without fail, returned to the soil. This is done *simply by burying the bagasse and trash*, with the addition of lime, to hasten decomposition. If the *bagasse* is burned, as is sometimes the case when there is a deficiency of fuel, the ashes should be carried and spread on the field.

From the above table of the ash of cane, we see that potash, in some form, is highly essential, as well as lime, common salt, sulphates and phosphates. These and other fertilizing materials can be procured in adequate proportions from stable manures, if the latter are to be had; but when there is a deficiency of them, the land may be restored by adding most or all of the following ingredients: Potash—ashes will afford it with the most economy and in the greatest abundance; it is yielded by the slow decay of vegetable matter, and stable manure, and also from the decomposition of many species of rocks, especially from *green sand marl. Lime, marl, or ground shells*—these are mostly pure carbonates, with, sometimes, a slight addition of the phosphate of lime. Land plaster, gypsum, or the phosphate of lime, is a cheap and appropriate fertilizer, as it yields the plant both sulphuric acid and lime. Ground bones or phosphate of lime, common salt (chloride of sodium), seems, from the analysis, to be a direct food for the plant.

DRAINAGE.

Deep, thorough under-drainage, is peculiarly necessary in preparing the sugar lands of the South to yield their greatest crops and choicest quality of sugar cane. All the advantages enumerated under the head of draining, will apply here. The cane on thoroughly drained lands will commence growing earlier in the spring than on the undrained; it will grow faster during the summer, ripen earlier and mature a larger portion of stalk, and yield a better, richer juice.—[*Condensed from Allen's American Farm Book.*

RICE—(*Oryza Satira*).

This grain probably contributes directly to the support of a larger number of the human family, than any other plant.

VARIETIES.

All the varieties yet discovered, flourish best under the inundation system of culture; yield more to the acre, give less trouble, and require less labor. Each variety will grow well on light, moist uplands, without irrigation, when cultivated with the hoe or plow.

CULTIVATION OF LOWLAND RICE.

The method pursued on the rice lands of the lower Mississippi, is to sow the rice broadcast, about as thick as wheat, and harrow it in with a light harrow with many teeth; th ground being first well plowed and prepared, by ditches and embankments for inundation. It is generally sown in March, and immediately after the sowing, the water is let on, so as barely to overflow the ground; the water is withdrawn the second or fourth day, or as soon as the grain begins to swell. The rice, very soon after, comes up and grows finely. When it has attained about three inches in height, tl e water is again let on, the top leaves being left a little above the water. Complete immersion would kill the plant. About two weeks previous to harvest, the water is drawn off to give the stalks strength, and to dry the ground for the convenience of the reapers. *The same space of ground, yields three times as much rice as wheat.* The only labor after sowing, is to see that the rice is properly irrigated; except, in some localities where aquatic plants prove troublesome, the water effectually destroying all others. The rice grounds of the lower Mississippi, produce about seventy-five dollars' worth of rice per acre. The variety called the Creole white rice, is esteemed the most profitable and best.

CULTIVATION OF UPLAND RICE.

In the eastern part of the State of Mississippi, called the *piney woods,* rice has been very generally cultivated upon the uplands. Although it cannot be made a profitable article of export, yet it affords the people of the interior an abundant supply of a healthy food for themselves, and a good provender for their cattle. Unlike other kinds of grain, it can be kept for many years, in a warm climate, without spoiling; by winnowing it semi-annually.

It is cultivated entirely with the plow and harrow, and grows well on the *pine barrens.* A kind of shovel-plow, drawn by one horse, is driven through the unbroken pine forest; not a tree being cut or belted, and no grubbing being necessary, as there is little or no undergrowth. The plow makes a shallow furrow, an inch or two in depth; the furrows are placed about three feet apart. The rice is dropped into them and covered with a harrow. The middles, or space between the rows, are not broken up until the rice attains several inches in height. One or two plowings suffice in the piney woods for its cultivation, weeds and grass, owing to the nature of the soil, not being troublesome.

There are two kinds of rice, said to succeed best on uplands, the long and the round. The *long*, has a red chaff, and is very difficult to beat out. The round shakes out, if not cut as soon as ripe. They, nevertheless, all succeed best under the inundation system of culture, for rice is essentially a water plant.

Before the war, the best rice lands of South Carolina and Georgia, were valued at five hundred dollars per acre; while the best cotton lands sold for one-tenth part of that sum; proving that rice was more profitable than cotton. The profit of a crop of rice, should not be estimated by the yield per acre, but by the number of acres a laborer can till. After the land is properly prepared for inundation, by levelling, ditching, and embankments, a single individual can grow rice almost without limit. If Chinese labor is introduced into the lower Valley of the Mississippi, rice is ultimately destined to supercede *cotton*, in a large portion of the States of Mississippi and Louisiana.

From the immense extent of our lowlands throughout the delta of the Mississippi, which, if subjected to the inundating system for growing rice, may be considered of inexhaustible fertility, we may expect at some future day, not very distant, to surpass every other portion of the world in the quantity, as we do now in the quality, of our rice.—(*Condensed from Allen's American Farm Book.*)

CHAPTER XX.

RECAPITULATION OF SOME OF THE MOST IMPORTANT FACTS.

When a vegetable substance is burned the mass of it disappears, taking the form of gases and escaping into the air, and a small residue remains, termed *ashes.* Now, when plants grow, they draw back again from the air all those gases which escape into it by combustion, and obtain from the soil only those mineral solids which form ashes. The great bulk of vegetable matter is derived from the air, and as the atmosphere is uniform in composition, that portion of the nutrition of plants which depends on this source may go forward in *all places* with nearly equal facility.

The atmosphere contains an exhaustless store of elements for the use of vegetation, and as far as *it alone* is concerned, all plants may be grown with equal success in *all places.* But other agencies step in *and say no.* As, for instance, *heat* and *light*, which radiate from the sun. In consequence of the almost round shape of *the earth*, these *rays* fall unequally upon its different parts. At the equator, where the rays are perpendicular, the heat and light are more intense, while we pass toward the *poles* the rays strike the earth more obliquely, and the heat is not as great. Now, to the variations of temperature plants are adapted. Equatorial vegetation requiring large quanties of heat and light, cannot flourish in temperate climates, for although the air and soil may contain all the chemical elements necessary to its growth, yet one of the conditions essential to it is wanting, namely, heat and light. In addition to the part played by the atmosphere and climate, which may be regarded in a measure as independent of human control, there is a third condition of the growth of plants which relates to the composition of soils. If there is a want of elements, derived from the soil, growth is impossible; but if they are abundantly supplied, nutrition is rapid, and growth will be luxuriant. To ascertain and regulate the adaptation of soils to plants, to find out the elements necessary for their development, and the best and most economical method of supplying them, is the great *problem* of agriculture. This problem we have endeavored to *work out* in the preceding chapters of this work. We have collected facts, illustrations and experiments from every reliable and available source. In growing cultivated plants, we cannot depend entirely upon the elements of the air. A plant snpplied with all the mineral substances in the soil, and *allowed sufficient time*, will extract the necessary gases from the air, and attain a vigorous development. But if it is desired to hasten the maturity of the plant, as is frequently necessary in certain climates, or to stimulate it to excessive growth, then vegetable or animal manures must be added to the soil, which, by decay and putrification, generate large quantities of *carbonic acid* and *ammonia* in the immediate neighborhood of the roots, by which they are taken up when dissolved in water.

The "ashes" or mineral elements of plants, though small in quantity, yet are of the very highest importance. Unlike the organic elements, which are the same in all plants, these vary in different varieties of vegetation.

As one kind of plant takes up one mineral from the soil, and others take other kinds, the farmer finds it advantageous to cultivate in succession different varieties of plants on the same grounds; this is called rotation of crops.

If a soil yields good crops of one vegetable, and not of another, it must be wanting in the mineral elements of the latter, which should be supplied. If any particular plant, cultivated or wild, flourishes in any given spot, an examination or analysis of the ashes indicates at once the capabilities of the soil by showing what soluble salts it furnishes.

Decaying vegetable and animal matters, when applied to crops, act not only in supplying *carbonic acid* and *ammonia*, but by furnishing such mineral salts as are contained in them, and that, too, in the very best condition to be taken up by plants. Hence for any particular crop there is no manure so good as the same kind of vegetable in a state of decay, or its ashes, or the droppings of animals fed upon it; but in the latter case it is of the first importance to make use of the *whole* manure of the animal, as its liquid excretions, the part most liable to be lost, are by far the richest in soluble salts.

Nature seems to have made it a *fixed law* that if one of the important ingredients of the plant is absent, the others, though they may be present in sufficient quantities, *cannot be used*. This, if the soil is deficient in alkalies, and still has sufficient quantities of all the other ingredients, the plant cannot take these ingredients, because *alkalies* are necessary to its growth.

In the case of all plants, the following operations are going on at the same time: The leaves are absorbing carbonic acid from the air, and the roots are drinking in water from the soil. There is a constant tendency to supply the deficiency of water in the root, and keep it constantly charged with as much as it can dissolve of the plant food.

Under the influence of daylight the carbonic acid is decomposed, its oxygen returned to the air, and its *carbon* retained in the plant.

Water taken in by the roots circulates through the sap vessels of the plant, and is drawn toward the leaves, where it is evaporated. This water contains the *nitrogen* and mineral food required by the plant, and some carbonic acid, while the water itself consists of *hydrogen* and *oxygen*. Thus we see plants obtain their food in the following manner:

Carbon, in the form of carbonic acid, from the atmosphere, and from that contained in the sap, the oxygen being returned to the air.

Oxygen and hydrogen, from the elements of the water constituting sap.

Nitrogen, from the soil, chiefly in the form of ammonia. It is carried into the plant through the roots, in solution in water.

Mineral elements, from the soil, and only in *solution* in water.

The food taken up by the plant undergoes such changes as are required for its growth; the nutritive portions of the sap are resolved into wood, bark, grain or other necessary parts.

The results of these changes are of the greatest importance in agriculture, and no person ought to be called a thoroughly *practical farmer*, who does not understand them.

We have thus far examined the *raw* material of plants. We have looked at each of the elements, separately, and considered its uses in vegetable growth. We will now consider another division of plants.

We know that they consist of various substances, such as wood, gum, starch, oil, etc., and on examination, we shall discover that these substances are composed of the various *atmospheric* and mineral ingredients described in the preceding chapters. They are made up almost entirely of *atmospheric* matter, but their ashy parts, though small, are of great importance.

These compounds may be divided into two classes. The first class is composed of *carbon*, *hydrogen* and oxygen. The second class contains the same substance, and *nitrogen.*

The first class—that containing no nitrogen—comprises the wood, starch, gum, sugar and fatty matter, which constitutes the greater part of all plants; also, the acids which are found in some fruits, etc.

Various as are all of these things in their character, they are *entirely* composed of the same ingredients (*carbon*, hydrogen and oxygen), only slightly differing in proportions. There may be a slight difference in the composition of their ashes, but the vegetable parts derived from the atmosphere, vary so little that they can often be artificially changed from one to the other. As an illustration of this fact, it may be stated that, at the fair of the Mechanics' Institute, Professor Mapes exhibited samples of excellent sugar made from the juice of corn-stalks, from starch, from linen, and from woody fibre.

In the plant, during its growth, these elements are constantly changing. At one time they assume the form in which they cannot be dissolved in water, and remain fixed in their places.

At another time, the chemical influences on which growth depends, change them to a soluble form, and they are carried by circulation of the sap, to other parts of the plant, where they may again be deposited in other *insoluble* forms.

As an illustration, the turnip devotes the first season of its growth to storing up, in its root, a large amount of starch and pectic acid; in the second season (when set out for seed), these substances become soluble, are taken up by the circulation, and again deposited in the form of woody fibre, starch, etc., in the stems, leaves, and seed-vessels, above the ground. If a turnip root be placed, in the spring, in moist cotton-lint, from which it can obtain no food, it will simply, by the *transformation* of its own *substance*, form stems, leaves, *flowers*, and *seed*.

Those products of vegetation which contain nitrogen, are of the greatest importance to the farmer, being the ones from which animal muscle is made.

They consist, as will be recollected, of carbon, hydrogen, oxygen, and *nitrogen*, or of *all* of the *atmospheric* elements of plants. They are all of much the same character, though each kind of plant has its *peculiar* form of this substance, which is known under the general name of *protein*.

The protein of wheat is called *gluten*—that of Indian corn is *zein*—that of beans and peas is *legumin.* In other plants, the protective substances are *vegetable albumen,* cassin, etc.

Gluten absorbs large quantities of water, which causes it to swell to a great size, and become full of holes. Flour which contains much gluten, makes light, porous bread, and is preferred by bakers, because it absorbs so large an amount of water.

These nitrogen compounds are necessary to animal and vegetable life, and none of our cultivated plants will attain maturity, unless allowed the material required for forming them. To form these, is the chief object of nitrogen given to plants as manure. If no *nitrogen* could be obtained, these substaaces could not be formed, and the plant would cease to grow. On the contrary, if *ammonia* is given to the soil, by rains, guano or stable manure, it furnishes *nitrogen,* while the carbonic acid, and water, yield the other constituents of *protein,* and a healthy growth continues; *provided,* the soil already contains the mineral matters required in the formation of the *ash,* in a condition to be taken up by roots.

The wisdom of this provision is evident, when we recollect that the *nitrogen compounds* are necessary to the formation of muscle in animals, for, if plants were allowed to complete their growth without a supply of nitrogen, our grain, grass, and hay, would not be sufficiently supplied to keep our oxen and horses in working condition.

THE RELATION BETWEEN PLANTS AND ANIMALS.

That this matter may be clearly understood, it may be well to explain more fully the application of the different constituents of plants in feeding animals.

Animals are composed (like plants) of *atmospheric* and mineral matter, and everything necessary to build them up, exists in plants. It is one of the offices of the vegetable world, to prepare the grass in the air, and the minerals in the earth, for the use of animal life; and, to effect this, plants put these gases and minerals together in wheat, corn, oats, barley and, in fact, all the productions of the earth.

In animals, the compounds containing *no nitrogen*, comprise the fatty substances, parts of the blood, etc., while the protein compounds, or those which *contain nitrogen*, form the muscle, blood, a part of the bones, the hair, and other portions of the body.

Animals contain a larger proportion of mineral matter than plants do. Bones contain a large quantity of *phosphate* of lime, and we find other mineral compounds performing important offices in the system.

In order that animals may be perfectly developed, they must, of course, receive as food, all of the materials required to form their bodies. They cannot live, if fed entirely on one ingredient. Thus, for example, if *starch* alone be eaten by the animal, he might become *fat*, but his strength would soon fail, because his food contains nothing to keep up the vigor of the *muscles*. If, on the contrary, the food of an animal consisted entirely of *gluten*, he might be very strong from the development of muscle, but would not become fat.

Hence, we see, that in order to keep up the *proper proportion* of both *fat and muscle* in our animals, *or in ourselves*, the food must be such as contains a proper proportion of both classes of vegetable products.

Apart from the relations between the *organic* parts of plants, and those of animals, there exists an important relation between their *ashes* or their *mineral* parts; and food, in order to supply the demands of animal life, must contain the mineral matter required for the purposes of life.

Take bones, for instance: If *phosphate of lime* is not always supplied, in sufficient quantities, in the food, animals are prevented from forming healthy bones. This is particularly noticed in the teeth. When food is deficient in the phosphate of lime, we see poor teeth as the result.

Some eminent physicians have supposed that one of the causes of consumption, is the deficiency of phosphate of lime in food. The first class of vegetable constituents (starch, sugar, gum, etc)., performs an important office in the animal economy, aside from their use in making fat. They constitute the *fuel*, which supplies the animal's *fire*, and gives him *heat*. The lungs are the delicate stoves, which supply the whole body with heat.

Let us explain this matter more fully. If wood, starch, gum, or sugar, be burned in a stove, they produce heat. These substances consist of carbon, hydrogen, and oxygen, and when they are destroyed in any way (provided they are exposed to the air), the hydrogen and oxygen unite and form water, and the carbon unites with the oxygen of the air, and forms carbonic acid. This process is always accompanied by the production of *heat*, and the *intensity* of this heat depends on the *time* occupied in its production.

In the lungs and blood vessels of animals, the same law holds true. The blood contains carbonaceous matters, and they undergo, during circulation, the changes which have been described, that is, combustion and decay. Their hydrogen and oxygen unite, and form the moisture of the breath, while their carbon is combined with the oxygen of the air, breathed into the lungs, and is thrown out as carbonic acid gas. The same consequence—*heat*—results in this, as in the other cases, and this heat is produced with sufficient rapidity for the necessities of the animal. When he exercises violently, his blood circulates with increased rapidity, thus carrying carbon more rapidly to the lungs. The breath also becomes quicker, thus supplying increased quantities of oxygen. In this way, decomposition becomes more rapid, and the animal is heated in proportion.

Thus, we see food has another office, besides that of forming animal matter, namely, to supply *heat*. When food does not contain a sufficient quantity of starch, sugar, etc., to answer the demands of the system, the *animal's own fat* is carried to the lungs, and then used in the production of heat.

CHAPTER XXI.

THE VALUE OF CROPS AS FOOD.

The ingredients of plants which serve valuable purposes as *food*, are *starch*, *sugar*, *gum*, protein matter, oil, woody fibre, water, and *salts*. *Starch* is the most abundant element in grain crops, forming about one-half the weight of the most common cereal grains;

but in these, proportions vary to some considerable extent. Even in the same species of grain, the quantity of *starch* differs in accordance with the circumstances of climate, soil and culture.

Wheat contains about from forty to fifty per cent. of starch. *Corn* varies less widely in its proportion of starch, ranging from forty to forty-five per cent. The white, soft varieties of both wheat and corn abound most in starch. Rye, *oats*, *buckwheat*, and beans, do not vary widely from corn, nor from one another, in the per centum of this element. Rice has about seventy per cent. Potatoes contain fifteen per cent. of starch; and even *hay*, about three to five per cent.

Gum and *sugar* are very similar to each other, and very similar to starch in their nutritive value. They are found in nearly all of our cultivated crops, in quantities varying from two to fifteen per cent. *Hay* cut in good time, has more of the substances than we find in any of the ordinary grains, except rye.

Protein compounds are composed, in part, of *nitrogen*. They resemble most of the muscular and membraneous parts of animals, and constitute the elements of food which nourish these parts of the animal body. As the greater part of the solid portion of the animal is made up of *protein matter*, it may be regarded as consisting of the *concentrated* protein of the food consumed during its growth. Hence, we see the importance of this kind of food in building up the animal system.

Beans and *peas* contain more protein matter than is found in any other of our crops. It exists here in a form called "legumin," and in quantity as high as twenty-five per cent. The cereals (grain) have from ten to twenty per cent. of this kind of matter, chiefly in the form of "*gluten.*" It is most abundant on the inner surface of the bran, and is taken out largely with it in the preparation of flour. This gives to wheat bran a nutritive value greater than its appearance would indicate.

This important kind of matter is, also, found in grass, hay, and to some extent in straw. Green clover, and clover hay, also hay made of pea vines, owe much of their value to the presence of protein matter. *Cabbage* contains not a little of it, and is, hence, quite nutritious. Rice contains less than any other grain, of this very important element.

Oil is found to exist in some form in almost every plant, and in almost all parts of every plant. In passing through the digestive organs, the vegetable oils undergo such changes as convert them into the varieties of fat peculiar to different animals. Those grains which abound most in oily matter, within certain limits, are best fitted for food, where fattening is the leading object. Some seeds, such as those of flax, hemp and cotton, contain too much oil to be fed alone. These, when ground into meal, and have their oil pressed out by machinery, the cake which is left, still contains enough oil, together with starch, gluten, etc., to make a valuable article of food for stock.

Indian corn has a larger quantity of oil in it than is found in the other cereal grains, having from eight to ten per cent. Oats, which have about five or six per cent., come next in order. Wheat and rye contain two or three per cent. of oil, while rice and buckwheat have not more than one per cent. The oily matter in good hay ranges from two to four per cent., and it is by no means wanting in straw which has been cut in good time.

Woody fibre, when dried, is chiefly indigestible, and yet serves an important purpose in promoting the digestion of other constituents of food with which it is mingled. Its presence makes the mass of food porous, so as to be easily penetrated by the fluids of the digestive organs. It also keeps the stomach and intestines properly distended. *Hay* and straw are composed, to a great extent, of woody fibre. In grain, the bran contains most of the fibre.

Water is a constituent of the dryest articles of food. The ripest grain and the dryest straw and hay, have seldom less than eight to ten per cent. of water in them. Potatoes contain about seventy-five per cent. of water, while turnips, and other root crops of similar kind, have as much as eighty-five per cent. of water.

The *mineral elements* contained in food crops are not to be disregarded in estimating their value. The animal system demands mineral as well as vegetable elements, to promote its growth and healthy development. The bones must be provided with *phosphate* of lime, and the fluids of the body with salts of *soda* and potash. These mineral substances are always found in the animal body.

Of the substances which give to articles of food their chief value, we place the *protein compounds first*, because they do more toward building up the animal system; they are more nutritious. In fact, they are often spoken of as constituting *the nutritious part* of food. Starch, gum and sugar may be classed together, since they serve a like purpose in sustaining animal life. After undergoing digestion, they are all thrown into the veins, where they become a constituent part of the blood, to be consumed during respiration. They are not less essential to animal life than other forms of diet; yet, from their abundance in vegetable products, they are not estimated at so high a value as the protein and oily parts of plants.

To estimate the value of the crop grown upon a given piece of ground, we must not simply take into account the relative quantities of these three kinds of food contained in a given weight of the crop, but the quantities contained in the whole product of the land. A hundred pounds of potatoes contain only about one-eighth as much protein matter as the same weight of corn, one-ninth as much oily substance and one-third as much starch. This shows that a given weight of potatoes is far inferior in value to the same weight of corn.

But when we compare the products of an *acre* of land cultivated in corn, with the product of an acre cultivated in potatoes, the case stands differently. In order to institute such a comparison, we may suppose that an acre which would yield sixty bushels of corn, or about 3500 pound of corn, would, if properly cultivated, yield four hundred bushels of potatoes, or 20,000 pounds. Thus we see that the feeding value of the potatoes on one *acre* may greatly surpass corn.

From the above principles and facts, we will find a mixture of grain and hay, or fodder, as affording probably the best combination of those properties which adapt food to the use of work animals. We find in these the requisite amount of protein compounds for keeping up muscular strength; of starch, gum, and sugar, for supplying fuel for respiration; of oil, to prevent exhaustion of fat; and of vegetable fibre, to prevent constipation and aid digestion. The perfection of horse provender is, perhaps, found in good clover or timothy hay, and corn meal; the hay being cut up and mixed with the meal.

An occasional change of food is promotive of health, provided only wholesome food is always given. The addition of a little wheat or bran, or a few potatoes, carrots, beets, or pumpkins, cut into fragments, and mixed with their usual food, improve their health. The effects will be seen in a more soft and pliant condition of the skin, and in the improved, glossy appearance of the hair.

If the object in view is to *fatten* an animal with the greatest possible rapidity, the chief point in which his food should differ from that of the growing animal, should be in the relative quantity of oily matter contained in it. While it should be adapted to sustain, and even increase the muscular and membraneous parts of the body, it should be more especially adapted to the filling up of the fat tissues. It, therefore, contains as much oil as is consistent with healthful digestion.

We have seen that *corn* is more abundantly supplied with oily matter than any other of the grains commonly used in feeding. Next to it, the oat is most prominent. There are some other seeds, such as flax seed, cotton seed and rape seed which abound still more in oil, but, as before stated, they contain far too much to be wholesome when fed alone; but they are sometimes advantageously mixed with forms of food which are deficient in oil. The grasses, whether eaten green or as hay, have oil enough to make them highly valuable for fattening stock.

PREPARATION OF FOOD FOR STOCK.

There are some important *points* involved in the preparation of food which demand the farmers attention. Economy in feeding requires not only the right kind of food, but also such *preparation* as will give the food its *greatest value.* It must be in such condition that the animals to be fed will *relish it;* that they will consume it entirely *without waste,* and that it shall all be *digested,* and thus fitted for the purposes it is intended to serve.

We often see provender rejected by cattle, because its condition is that of coarse, dry, hard, stalks or straw difficult to masticate, and often insipid, when eaten alone. Again we see choice portions of hay and fodder picked out by horses, and the remainder pulled down and trodden under foot. Then we often find whole grains passed through animals, as may be seen in the droppings of cattle, when fed on unground corn, or of horses, when fed on unground oats. To avoid such waste, we must pay attention to the most economical means of reducing provender to the best and most palatable condition.

The means best adapted to the preparation of food are *cutting, grinding, mixing* and *boiling* or *steaming.* Cutting aids both mastication and digestion. The question here arises: "Will it pay?" This must be decided by the circumstances of the case. If the farmer has a great deal more straw and fodder than his stock will consume, and wishes to use the excess as litter to absorb liquid manure, he may not find any economy in cutting the food. And even in the case of feeding hay, if the supply is abundant and price low, as is frequently the case in grass-growing regions, it may be more economical to feed it whole, even with considerable waste, than to expend upon it the necessary labor to cut it up. In sections of country where such *provender* is scarce, or where there is a sufficient demand for it, to keep up the *price good*, "cutters" will be among the most economical implements on the farm. And they are no less so in towns and cities when horses and cows are fed at considerable cost.

Grinding sustains very much the same relation to grain that cutting does to long forage; but, as grain is more readily transported than other products of the farm, economy in its use becomes more highly important. Grinding is thought by many experienced farmers to add from twenty to thirty per cent. to the nutritive value of grain when fed to hogs or horses, and from forty to fifty per cent. when fed to cows. The cow masticates grain much less completely than either the hog or the horse. In autumn, before corn has become hard, there is but little advantage in grinding it for hogs. *Mixing* may be added to cutting and grinding with marked advantage. When horses or cattle are fed on any kind of long forage (hay, straw, fodder or shucks), together with meal or bran, the former should be finely cut, and the latter mixed with it—water enough being added to make the meal or bran adhere. There will then a double advantage arise;

first, of having the whole completely eaten up without waste; and, secondly, more perfectly masticated and digested. A similar advantage arises from cutting beets, turnips, carrots, pumpkins, etc., and mixing them with meal.

In localities remote from the sea shore, where vegetation affords too little of the salts of soda to supply the demands of the animal fluids, common salt should be mixed with the food, or else a supply kept in a sheltered place, so that stock may get it when they want it. From four to five quarts sprinkled on a ton of hay or fodder, when stored away, will greatly improve its quality and aid in its preservation. A small quantity of salt is beneficial to hogs, if given regularly, but large doses are very *poisonous.*

Boiling and steaming render substances more soluble, and in that way promote digestion. Steaming may be profitably applied to hay when fed to young animals, and to sheep, whether old or young. Green grass is more valuable than hay made from it. In making hay there are changes produced in the stalk and blades, partly physical and partly chemical. Among these changes is the greater *insolubility of the fibre.* This makes it indigestible. Steaming reduces it back to a condition somewhat similar to that of green grass.

Boiling may be applied to grain, either whole or ground. It renders the starch more soluble; and, if in the case of meal, a slight fermentation is produced before boiling, a large portion of the starch will be changed to *dextrine.* This is one of the steps in the progress of digestion already made. Roots should generally be boiled or steamed.

If our object is to make food perform its office as rapidly as possible, that is, if we wish it to cause rapid growth and rapid fattening, the most digestible condition is the *best.* In such cases the animals should be kept comfortable and quiet, and there will be but little waste of food. Boiling is especially adapted to hogs, and almost indispensable to the thrifty growth of young pigs.

For horses and work oxen the boiling of meal is a *disadvantage.* The digestion then goes on too rapidly. If the grain is ground, and mixed with cut hay or straw, the digestion is made complete, and goes on more slowly. In this way the digestive organs are not so quickly *left inactive*, and the sensation of hunger is not so soon produced.

CARE OF STOCK.

Farmers lose more in the Southern States by the careless treatment of stock than by carelessness in anything else. Hundreds of dollars are often lost in this way, which might readily have been saved by a little timely attention. Young animals, which require more attention than all others, are most frequently neglected, both as to shelter and food. Many in this way are lost, and many others so much stunted as never to regain their full vigor. Every farmer will find it to his interest to give special attention to his colts, calves and pigs.

HORSES.

The stables should be *well lighted*, well ventilated. *Pure, fresh air* is not less important for any animal than good wholesome food. The lungs are capable of transmitting other gases, besides oxygen, to the blood. If stables are not well aired, the horses necessarily breathe ammonia and other affluvia in mixture with the confined air in which they live. This will soon enfeeble their health. Ventilation and the sprinkling of plaster, or woods mold in their stalls, is the remedy.

The *temperature* of stables should not be disregarded. They should be neither too warm nor too cold. If they are very warm, the horses become severely chilled when brought out in the cold air. If very cold, the waste of animal heat requires a largely increased consumption of grain food. *Kindness* does more to bring animals completely under the control of man than any and all the other means; and, of all animals, the horse is the most sensitive to kind treatment. When colts are treated with a kind hand from the very commencement of life, if dealt with *gently* when first trained to the saddle or harness, they seldom give their owners much trouble, and are afterwards more safe and useless.

CATTLE.

Dry, clean sheds, well littered, and opening toward the south, make the best protection for horned cattle in the winter. In very cold, wet weather, it may be well to confine them to their shelters; but generally in fair weather they thrive better if they have the use of an open lot, supplied with corn stalks, straw or leaves, to keep down the mud and make manure. When cattle are to be fattened they should be kept as quiet as possible. If allowed to run at large they take too much exercise, and thus waste both muscle and fat. This plan, of course, cannot be pursued when cattle run on pasture while fattening.

HOGS.

These are the most neglected of all domestic animals in the Southern States. Many a poor hog never knows what it is to enjoy a comfortable shelter during the whole of his precarious existence. There is scarcely any animal more sensitive to the extremes of heat and cold. We see at once the importance of having them provided with a comfortable shelter against the hot suns of summer, and the cold winds of winter.

"BAD HABITS."

Bad fences are the *cause* of bad habits; good fences are sometimes the *cure*, but always the *preventive*. Good enclosures are economical. Almost every rickety fence on a farm is the cause of more loss of time and crops, in a few years, than would build a new, substantial fence. If your fences are always kept in good order, your stock will never learn *bad habits*.

CHAPTER XXII.

CONCLUSION TO PART FIRST.

The life of the farmer, like that of men in other pursuits, must have its toils, its trials, its perplexities, and its disappointments; but it has, at the same time, rare sources of pleasure and comfort. It is the most independent of all departments of industry. It is true, there is a mutual dependence pervading all the classes of society, but none have to rely so little on the *capricious patronage* of their fellow-man as the successful cultivators of the soil. Every farmer should take a pride in his ennobling profession; he should feel that he is a member of that class upon which our country is chiefly dependent for its wealth and prosperity. The farming interests lie at the foundation of our national greatness. The farmers nourish, and enrich the nation.

The land-holders of our country are the conservators of the present patriotism. They are always the most stable and reliable citizens of this or any other land. No other class of the people have their interests so closely and completely identified with the general and permament good of every part of our country—none can be more warmly attached to. their native soil—and none are found more ready to raise the strong arm of resistance against oppression, from whatever source it may come. Of course, we speak here of the *practical* and *intelligent* farmer. The man of mind—one who carries his *brains* with him to his fields, and who knows, or seeks to know, the "why" and the "wherefore" for all the operations of *nature* on his farm—one who has more mind than the senseless clod he crushes under his heel. He puts in practice the deductions drawn from science and experience, and intelligently makes subservent to his *will,* all the aid which science and the arts can yield him. All the *clap-trap* about it being necessary to work the ground with his own hands, to be a practical farmer, is absolutely absurd. We question whether Morse, the inventor of the magnetic telegraph, could make with his own hands, even one of the screws, required for his instrument; but he had the mind to plan and direct, and procured experienced instrument makers to do the work. We doubt very much whether Stephenson (the celebrated English engineer), could make even a rivet, to fasten the tubes together in his great iron, tubular bridge; yet he had the intelligence to comprehend, and the will to have executed, one of the most magnificent structures that ever astonished the eyes of a wondering world.

Can we say such men are not practical, because they cannot make a screw, or a small rivet of iron? Their work stand the test of practicability. Such men are the practical men of the world, who can by deep thought and study, harness the very lightnings of heaven, and overcome all physical obstructions in nature. We cannot forbear inserting in this place, a parallel drawn between two farmers, taken from George E. Warren's Elements of Agriculture, a work well worthy the perusal of every farmer.

Who is the *practical farmer?*" Let us look at two pictures, and decide. Here is a farm of one hundred acres, in ordinary condition. It is owned and tilled by a hard-working man, who, in the busy season, employs one or two assistants. The farm is free from debt, but it does not produce an abundant income; therefore, its owner cannot afford to purchase the best implements, or make other needed improvements; besides, he don't *believe* in such things. His father was a good, solid farmer; so was his grandfather; and so is he, or thinks he is. He is satisfied that "the good old way" is best, and sticks to it. He works from morning till night, from spring till fall. In the winter, he *rests* as much as his lessened duties will allow. During this time, he reads little, or nothing. Least of all, does he read about farming. He don't want to learn how to dig *potatoes from a book.* Book farming is all nonsense. Many other similar ideas keep him from agricultural reading. His house is comfortable, and his barns are quite as good as his neighbors', while his farm gives him a living. It is true, that his soil does not produce as much as it did ten years ago, but prices are better, and he is satisfied. Let us look at his premises, and see how his affairs are managed. First, examine the land. Well, it is good, fair soil; some of it a little springy, but it is not to be called *wet.* When first laid down, will produce a ton and a half of hay to to the acre—it used to produce two tons. There are some stones and stumps on the land, but not enough, in his estimation, to do harm. The plowed fields are pretty good; they will produce thirty-five bushels of corn, thirteen bushels of wheat, or thirty bushels of oats per acre, when the season is not dry. His father used to get more; but, somehow the *weather* is not as favorable as it was in old times. He has thought of raising root crops, but they take more labor than he can afford to hire. Over in the back part of the land, there is a *muck-hole,* which is the only piece of *worthless* land on the farm. Now, let us look at the barns and barn-yards. The stables are pretty good; there are some wide cracks in the siding, but they help to ventilate, and make it healthy for the cattle. The manure is thrown out of the back window, and is left in piles under the eaves of the barn. The rains and sun makes it *nice* to handle. The cattle have to go some distance for water, and this gives them exercise. All of the cattle are not kept in the stable; the fattening stock are kept in various fields, where the hay is fed out to them from the stack. The barn-yard is often occupied by cattle, and is covered with their manure, where it lies until carted on to the land. In the shed, are the tools of the farm, consisting of carts, plows—not deep plows; this farmer thinks it best to have roots near the surface of the soil, where they can have the benefit of the sun's heat—a harrow, hoes, rakes, etc. These tools are all in good order; and, unlike those of his less prudent neighbor, they are protected from the weather. The crops are cultivated with plow and hoe, as they have been since the land was cleared, and as they always will be, until this man dies.

Here is a "practical farmer" of the present day. Hard-working, out of debt, and economical—of dollars and cents, if not of soil and manures. He is a better farmer than two-thirds of the three million farmers in the country. He is one of the best farmes in his county, there are but few better in the State. He represents the better average class of his profession. With all this, he is, in matters relating to his business, an unreading, unthinking man. He knows nothing of the first principles of farming, and is successful by the *indulgence of nature*, not because he understands her, and is able to make the most of her assistance.

This is an unpleasant fact, but it is one which cannot be denied. We do not say this to disparage the farmer, but to arouse him to a realization of his position, and of his power to improve it. But let us see where he is wrong.

He is wrong in thinking his land does not need draining. He is wrong in being satisfied with one and a half tons of hay to the acre, when he might easily get two and a half. He is wrong in reaping less than his father did, when he should get more. He is wrong in ascribing to the *weather*, and similar causes, what is due to the actual impoverishment of his soil. He is wrong in not raising turnips, carrots, and other roots, which his winter stock so much need, when they might be raised at a cost of less than one-third of their value in food. He is wrong, in considering worthless a deposit of *muck*, which is a mine of wealth, when properly employed. He is wrong, in the treatment of his manures, for he loses more than one-half their value from evaporation, fermentation and leaching. He is wrong, in not adding to his tools the deep surface plow, the subsoil plow, the cultivator, and many other implements of improved construction. He is wrong, in cultivating with plow and hand hoe those crops which could be better and more cheaply managed with the cultivator or *horse-hoe*. He is right in a few things; and but a few, as he himself would admit, had he that knowledge of his business, which he could obtain in the leisure hours of a single winter. Still he thinks himself a practical farmer.

In twenty years, we shall have fewer such, for our young men have the mental capacity, and mental energy, necessary to raise them to the highest point of *practical education*, and to that point they are gradually, but surely rising. We have far fewer now, than twenty years ago.

Let us now place this same farm in the hands of an educated and thinking cultivator; and at the end of five years, look at it again.

He has sold one-half of it, and cultivates but fifty acres. The money for which the other fifty were sold has been used in the improvement of the farm. The land has been underdrained, and shows the many improvements consequent on such treatment. The stones and stumps have been removed, leaving the surface of the soil smooth, and allowing the use of the subsoil plow, which, with the under drains, has more than doubled the productive power of the farm. Sufficient labor is employed to cultivate, with improved tools, extensive root crops, and they invariably give a large yield. The grass land produces a yearly average of two and a half tons of hay. From eighty to one hundred bushels of corn, thirty bushels of wheat, and forty-five bushels of oats, are the average crops gathered. The soil has been put in the best possible condition, while it is regularly supplied with manures containing *everything* taken away in the abundant crops. The principle that all mineral matter sold away must be brought back again, is never lost sight of in the application of manures. The *worthless muck-bed* was retained, and is made worth a dollar a load to the compost-heap, especially as the land requires an increase of vegetable matter. The manure from stalks and barn yards is carefully composted, either under a shed constructed for the purpose, or is thrown into a cellar below, where the hogs mix it with a large amount of *muck*, which has been in, after being thoroughly decomposed by the lime and salt mixture.

This farmer reads and thinks; his knowledge of the *reasons* of various agricultural effects enables him to discard the injudicious suggestion of the *book-farmers*, and uneducated dreamers, and take only the facts worthy of experiment.

Here are two specimen farmers. Neither description is over-drawn. The first is much more careful in his operations, than the majority of our farmers. The last, is no better than many who may be found in every State in the Union. We appeal to the common sense of the reader of this work, to know which of the two is the *practical farmer*—let him imitate either, as his judgment will dictate.

The author is aware that hardly any class of men are so difficult to be reached as farmers, and the undertaking is hazardous. They are terribly afraid of being "*humbugged*," and thereby very often humbug themselves. For years, this little work has been in the thoughts, and on the mind of the author. His own experience as a farmer, combined with study and observation, since he lost his leg in the late war, enables him to submit it to the farmers of the South, for their most careful attention.

Although farmers, as a class, are hard to convince, yet, no class of men are so open to conviction, so alive to manly principles, so susceptible of good impressions, when the effort to aid them is judicious, and worthy of attention.

END OF PART FIRST.

PART II.

APPENDIX.

The author, in presenting this brief outline of Agricultural Chemistry, as an Appendix to Part I of this book, wishes to show the "why and wherefore," certain fertilizers, manures, composts and stimulants, are applied to the soil, so that the farmer may see for himself, the best articles to use, as well as those which should be avoided. Too great a degree of caution cannot be observed, in the use of stimulating fertilizers; nor is it necessary that they should be applied in excessive quantities.

PART II.

(AN APPENDIX TO PART I.)

CHAPTER I.

CHEMISTRY, AS APPLIED TO THE SOIL.

THE SOIL, HOW FORMED, ETC., ETC.

Agricultural Chemistry aims to explain all the actions of earth, air, and water upon plants. It refers to all their chemical relations, to the geology, minerology and chemistry of soil.

Soil is the loose surface material covering rocks, in which the roots of plants are fixed, and is supposed to be formed by their decay. Both are to be classed by their origin. The origin of rocks refers not only to the mode of their first formation, but to their subsequent arrangement. The origin of all rocks, geology teaches, is from the matter of the globe. Referring rocks to their origin, they are divisible into two classes, viz:

First—Igneous, or those formed by fire.

Second—Aqueous, or those formed by water.

This division relates both to the origin and distribution. In their origin, rocks are truly igneous, or from fire. In their distribution, they are aqueous, or from water. This is the only division necessary to the farmer. It is the division taught and demanded by agricultural geology.

The first class (or those from fire), includes all highly crystalline rocks, such as granite, gneiss, sienite, greenstone; it includes, also, basalt and lava. The products of volcanos, both ancient and modern, should be placed in the same class.

The second (or that from water), includes sand, gravel, rounded and rolled stones of all sizes, pudding stones, conglomerates, sand-stones, and slates. When these various substances are examined, a large part of the sand is found to be composed essentially of the ingredients of *the igneous rocks.* This is true, also, of sand-stone, slate, and boulders.

FORMATION OF DEPOSITS.

There are large deposits, or formations, in various districts, composed almost entirely of some of the chemical constituents of the igneous rocks, united with an ingredient of air. These constituents are lime and magnesia; the portion derived from air is carbonic acid, forming, by their union, carbonates of lime and magnesia. Marble, limestone, and chalk, belong to this formation. The lime, originally a part of the igneous rocks, has been separated, and combined with air by animals and plants, by a vital process called secretion. The modern production of the carbonate of lime, is still going on under the forms of shells and corals. But limestone is truly a salt, rather than a rock, and should be classed with the salts.

The transportation, or distribution of the soil, by the effects of water, is a fact so well established, that it needs only to be mentioned. There has been an universal mingling of the loose materials of soil, derived from the worn down rocks and decayed vegetable matter. Great uniformity of the chemical composition, characterizes soils, as, also, more or less, the rocks, from which they have been formed.

CHAPTER II.

THE CHEMICAL INGREDIENTS OF ROCKS AND SOILS.

The geologist, mineralogist, and the chemist, each *view* rocks with a different eye. The geologist regards the rocky mass; the mineralogist, the simple minerals composing the rocks; the chemist, the simple elements which compose the mineral.

Elements are substances which as yet have not been proved to be compound; as oxygen and hydrogen among the gases, iron and lead among the metals.

The only point of view the farmer takes is that of the chemist. His pole-star is fruit and progress; and his mind, directed by the chemist, is taught the nature and mode of action of the several elements of the minerals.

As far as known, seven simple minerals compose the most important rocks, viz: quartz, mica, feldspar, talc, hornblende, augite and carbonate of lime. Other minerals are found in rocks, but these seven compose all those called geological formations, and which form the crust of the earth.

The chemical constitution of rocks, the nature, properties and relations of their elements, prove to be of the highest importance to the farmer, when it is known that the elements of these seven minerals are *also the earthy part or ashes of all plants.*

The number of elements which chemistry has detected, is sixty-two. These are classed as metallic or unmetallic. Of these, some are gaseous, others earthy, most of them combustible.

ELEMENTARY BODIES.

Of the simple elementary bodies, thirteen chiefly compose rocks and the mineral proportion of the soil. Six of this number are unmetallic, and seven are metallic substances, viz.:

The unmetallic are:	The metallic are:
1. Oxygen,	1. Potassium,
2. Hydrogen,	2. Sodium,
3. Silicon,	3. Calcium,
4. Carbon,	4. Magnesium,
5. Sulphur,	5. Aluminium,
6. Phosphorus.	6. Ferrum or Iron,
	7. Manganese.

Chemistry tells us how these gaseous and metallic substances combine, and the elements they form after combination. Oxygen has a wide range of affinities. It combines with the unmetallic substances—its compounds are called oxides—thus:

Oxygen	combined	with	Hydrogen	forms	Water.
"	"	"	Silicon	"	Silicic Acid.
"	"	"	Carbon	"	Carbonic Acid.
"	"	"	Sulphur	"	Sulphuric Acid.
"	"	"	Phosphorus	"	Phophoric Acid.

Again, with metallic substances:

Oxygen	combined	with	Potassium	forms	Potash.
"	"	"	Sodium	"	Soda.
"		"	Calcium	"	Lime.
"			Magnesium	"	Magnesia, etc.

BASES.

The oxydes of metals are termed *bases.* Potash, soda, lime and magnesia are termed alkiline bases; the others, metalic bases. Acids and bases unite and form salts in the soil. Thus, these unmetallic substances unite with metals, and form a class of compounds of the highest importance in agriculture. It is seen, therefore, that the elements composing rocks, are reduced to salts and metalloid compounds. The peculiar character of the salts formed by silicic acid, will be easier understood by separating these from the others under the name of silicates. These form the great bulk of the earths crust. The compounds of silicic acid would hardly be recognized as *salts,* in the common and popular sense of the term; with which is associated the idea of softness and solubility. Carbonic, sulphuric and phosphoric acids, form with bases, salts, in the usual sense of the term.

The elements which compose the silicates may be named in pairs, to aid the memory. First, the alkalies, potash and soda. Second, alkaline earths—lime and magnesia. Third, earths—silica or sand, and alumina. Thus, we have two alkalies, two alkaline earths, and two earths.

EXPERIMENTS—SILICA.

The term salt, silicate and metalloid compound, may need further explanation. Pearl ash and vinegar, are well known substances. One is an alkali, the other an acid. Pearl ash has the alkaline properties of a bitter, burning taste, and the power of changing vegetable blues to green, and pink to blue. Vinegar has the acid property of a sour taste, and of causing a hissing or effervescence, when poured on pearl ash. This action ceasing, there is neither acid taste or alkaline properties; the character of the vinegar and pearl ash has disappeared; the substances have united; they have formed a new substance, termed a *salt*.

The fact to be observed in the above experiment is, that an alkali and an acid mutually neutralize each other. The vinegar is popularly said in this case, to "*kill*" the pearl ash. So, soda, potash, lime, magnesia, etc., would all be "*killed*," or neutralized by vinegar, they would all be dissolved by it, and lose their distinguishing character. In either case, a neutral salt would be formed. Such a class of salts are called *acetates*, being formed by alkalies, alkaline earth, and metallic oxydes, united with acetic acid, or vinegar.

Silex or silica, or the earth of flints, is in its pure state, is a perfectly white, insipid, tasteless powder. It unites with bases in the form of silicic acid, forming neutral salts, termed silicates. Thus, are formed a large class, in which are found silicates, potash, soda, lime, magnesia, etc. This class forms the great bulk of all the rocks and soil.

METALLOID COMPOUNDS—SALTS.

The substances last mentioned are all metals, united with oxygen. They are *metallic oxides*. If the oxygen is removed and replaced by carbon, sulphur, or phosphorus, the combinations are called carburids, sulphids, phosphids.

Metalloid compounds are combinations of metalloids with metals, in their pure or unoxydized state.

Salts are combinations of metalloids with oxygen and the metals, in their rusted or oxydized state.

The formation of carbonic, sulphuric, and phosphoric acids, has been explained. [See article 15.] When these acids unite with bases, salts are formed, called carbonates, sulphates, phosphates.

Hence, when a substance is named, as for example, sulphate of lime, a definite idea of the nature of this compound is conveyed. It is at once known to be a salt, that is, a sulphate, that is, sulphur and oxygen united with lime. So too, phosphate of lime is seen to be a salt of lime.

The thirteen substances that enter into the composition of rocks, [see article 14,] are subject to *fixed laws* in their combinations, viz:

They combine only in definite proportions, or in multiples of the same. The combining number of a compound, is the sum of the combining numbers of the composing elements. If we assume the smallest combining weight, viz: that of hydrogen, as *one*, the combining weight of all other *elements* may be represented by definite numbers, expressing the proportions by weight in which they unite, not only with hydrogen, but also amongst themselves. Thus, when oxygen and hydrogen unite to form *water*, the proportions are:

Hydrogen	1
Oxygen	8
Water	9

It has been ascertained that the proportion in which the *bases* of the silicates combine with oxygen, are:

Oxygen	1 eq.,	or 8	with	one eq.,	21	of	Silican, = 29 Silica or sand.
"	" "	" 8	"	" "	10	"	Alumimen = 18 Almumina or clay.
"	" "	" 8	"	" "	20	"	Calcium = 28 Lime.
"	" "	" 8	"	" "	12	"	Magnesium = 20 Magnesia.
"	" "	" 8	"	" "	39	"	Potassium = 47 Potash.
"	" "	" 8	"	" "	23	"	Sodium = 31 Soda.

When oxydized substances combine with an acid, it is only in these proportions. The numbers are called equivalents; that is, 47 of potash is equal in saturating power to 31 of soda, or 28 of lime.

The equivalent of sulphur is 16, adding 3 equivalents of oxygen or 24, we have 40, or the equivalent of sulphuric acid. The equivalent of phosphorus is 32, adding 5 equivalents of oxygen, we have 40x32 = 72 phosphoric acid. The equivalent of carbon is 6x16, or 2 of oxygen = 22 carbonic acid. Hence, the equivalents of the acids are 40, 72, 22. These acids combine with bases in the above proportions, forming neutral salts, or with two or more proportions of acid, forming *super-salts*, or with a still larger proportion base, forming sub-salts; thus, are formed sulphate of lime or plaster, 28 lime x40 sulphuric acid. Carbonate of lime, 28 lime x22 carbonic acid. Phosphate of lime has a larger proportion of base, 3 parts or 84 of lime x72 phosphoric acid.

When the subject of the composition of the soil is discussed, the value of this slight knowledge of chemical rotation and combining proportions is manifest.

SIMPLE MINERALS.

Viewed by the light of chemistry, rocks are mostly masses of silicates. The simple minerals composing most rocks are truly, only silicates in fixed proportions. The simple minerals are quartz, feldspar, mica, hornblende, augite, talc. In each mineral, the base is combined with silica, which acts as an acid, a compound or silicate is formed.

1. The silicate of alumina (clay, earth), with potash, forms feldspar.

2. Silicate alumina and lime, with magnesia and iron oxyde, forms hornblende.

3. The silicate of magnesia, forms serpentine and talc, and silica almost pure in quartz.

This brings us to the third branch of our subject. The mineral ingredients of the soil, their properties and chemical action.

CHAPTER III.

THE PROPERTIES AND CHEMICAL ACTION OF THE MINERAL INGREDIENTS OF THE SOIL.

The bases of the silicates have common properties, which are:

1. Alkaline, as exhibited in potash and soda, and in a less degree in lime and magnesia, etc.

2. They are almost all soluble in water. Potash stands first here, also; the solubility decreases in lime, and totally disappears in alumina and clay.

3. They have a great affinity for carbonic acid. The order of affinity is potash, soda, lime, magnesia.

4. They all have a great affinity for water.

The metalloids or unmetallic substances, also, have common properties:

1. They combine with the pure base of silicates, and form *silicinrets*, phosphurets, carburets and sulphurets. Thus are formed carburet of iron or plum-

bago, sulphuret of iron or iron pyrites, and the sulphuret of potassium, or the liver of sulphur.

2. They chemically combine with each other. Thus are formed sulphuret of carbon, sulphuret of silicon, etc.

3. They all form acids by combining with oxygen. Thus are formed carbonic, sulphuric, phosphoric, and silicic acids.

NAMING ACIDS.

The rule followed in naming acids is, that each is called after the substance forming it, the metalloids having *ous* added, to denote the weaker, and *ic* to designate the stronger acids, thus:

1 sulphur 16x2 of oxygen = 16x16 = 22 sulphurous acid. 1 sulphur 16x3 of oxygen = 16x24 = 40 sulphuric acid. In the same way carbonic and phosphoric acids are formed. Silica or sand forms but one acid, silicic.

Silicon, from which silicic acid or silica is formed, requires a more extended notice. Silicon, when united with oxygen, forms pure rock crystal, quartz, agate, cornelian. It is this that forms the glazed coating to the rush and the grasses. Wheat, rye, oats, cornstalks, and barley owe their support to this covering of silicon *or sand.* It cases the bamboo and rattan with an armor of flint, from which, when dry, may be struck *sparks of fire.*

Silicon in the purest state yet obtained, is a dull brown powder, soiling the fingers. It dissolves in hydro-fluoric acid and in caustic potash. When heated with dry potash, it is converted into silicic acid. Silicic acid exists in two states, soluble and insoluble in water. Sulphuret of silicon dissolves in water, and gives silicon or sand in solution.

GLASS—ANALYSIS OF GRANITE.

The general properties which silicic acid exhibits in combination are these, viz.:

1. All its compounds with excess of alkali are caustic, *and soluble in water.*

2. Those with an excess of silicon or sand are mild and insoluble. Glass is an example of the last, and so are rocks. Green bottle glass is but a fused rock, a mixture of the silicates of potash, soda, magnesia, lime, and iron. These are the silicates which have been already noticed as composing rocks, and the amount and origin of those elements of the soil can now be easily comprehended. This is practical ground, and shows the value of the chemical analysis of rocks.

Let us take granite rock for an example. See of what it is composed?

ANALYSIS OF GRANITE ROCK.

Silex or Sand	74.84
Alumina (or clay—earth)	12.80
Potash	7.48
Magnesia	.99
Lime	.37
Oxide of Iron	1.93
Oxide of Manganese	.12
	.100

Thus, in every one hundred pounds of granite we have seven and a half pounds of potash and three-eighths of a pound of lime.

These elements do not exist in the soil *free;* they exist as silicates or salts, which are gradually acted upon by the carbonic acid of the air, and by the grow ing plants. The action of the carbonic acid upon the silicates separates the potash or the alkaline part of the silicate, and makes it soluble, to become food for plants.

The fact most important for the farmer in these changes is that the compounds are present in all soils, becoming salts and food for plants. Whenever iron pyrites or sulphuret of iron is found, and it is present in nearly all soils, exposure to air and moisture acidifies the sulphur, and forms *oil of vitriol* or *sulphuric acid*. This acid immediately combines with iron and forms copperas; or with alumina, forming alum; or with lime, forming sulphate of lime (plaster); or with magnesia, forming epsom salts. All these salts are liable to be decomposed by any soluble alkali, as carbonate of potash, soda, etc., which may be produced by the decomposition of the silicates.

Among the most important salts in the soil arising from these actions, are sulphate of lime (or plaster), phosphate of lime, and of alumina and iron. The sulphate of lime is partially soluble, but phosphates are more insoluble, and are always found in soil.

It is not easily understood how phosphate of lime exists in the soil, but that it does exist none can doubt. The proof may be stated in a few words. *Bones* of all grazing animals contain about half their weight of the phosphate of lime. It can be derived only from their food, and that from the soil. The actual result of chemical analysis confirms this statement. Beets, carrots, beans, peas, potatoes, cabbages, etc., afford phosphate of lime, magnesia and potash. Indian corn, rice, wheat, barley, oats, rye, and cotton seed and plant, contain sulphate and phosphate of lime, not only in the grain and seed, but in the straw and stalk. Every exact analysis of the ashes of trees, shrubs, and plants of every kind, cultivated or wild, shows the presence of phosphoric acid.

Having briefly discussed the mineral ingredients of the soil and their chemical action, we will now turn our attention to the organic or vegetable constituents of the soil.

CHAPTER IV.

THE VEGETABLE, OR ORGANIC CONSTITUENTS OF THE SOIL.

Soil consists of two grand divisions of elements: inorganic and organic. The inorganic are wholly mineral, formed by chemical action on the metallic and unmetallic elements of rocks. They existed before plants or animals. Life has not called them into existence, nor created them out of the simple constituents. Organic elements are the product of living organs, or of substances once endowed with life, hence called organic; and, when formed, they are subject to chemical laws. The number of elements in the organic parts of the soil does not exceed four, viz: oxygen, hydrogen, carbon, and nitrogen.

To have a clearer idea of this subject, we will give a description of each of these elements separately.

Oxygen (symbol O; combining weight 8).

This is one of the most important, as well as the most abundant, of elementary substances. It enters into the composition of almost everything we use around us. It constitutes eight-ninths the weight of water, and nearly one-fifth of the air. It is an abundant element in rocks and soil, and in nearly all vegetable and animal substances. The presence of oxygen in the air is necessary to support combustion, and, also, to sustain life. A mixture of oxygen 21 parts, and nitrogen 79 parts, is the air we breathe. Its action upon the soil is very beneficial, and will be noticed more fully hereafter.

Hydrogen (Symbol H; combining weight 1).

The name of this gas is derived from two Greek words signifying "generator of water," because with oxygen it forms water, H, 1xO, 8 or 1 part hydrogen and 8 parts oxygen forms water, = 9. The union of *hydrogen and nitrogen* forms *ammonia*, one of the most active fertilizers known to agriculture.

Carbon (Symbol C; combining weight 6).

Carbon is a very important element in nature. It constitutes the greater part of both plants and animals. It is the chief ingredient in the vast beds of mineral coal. The diamond is the present form of carbon. With oxygen it forms carbonic acid; thus, one part of carbon added to two parts of oxygen, or C, 6xO, 16=22 carbonic acid, which forms somewhat less than half the weight of limestone. Combustion and respiration consume oxygen, and generate carbónic acid, while vegetation consumes carbonic acid, and generates oxygen; thus, the equilibrium of the air is preserved in reference to these two gases.

Nitrogen (Symbol N; combining weight 14).

This gas, as before stated, constitutes about seventy-nine per cent., or four-fifths of the atmosphere which surrounds us. Thus, the air is twenty-one per cent. oxygen and seventy-nine per cent. nitrogen. It being one of the constituents of niter, or saltpeter, it is properly called nitrogen. When combined with oxygen, in the proportion of one combination weight of nitrogen to five combination weights of oxygen, thus: N, 14xO, 40, form nitric acid. Nitrogen exists in all animal substances, and in all plants, especially such as putrify with an animal odor, as, cabbages and mushrooms. Nitric acid, or aqua-fortis, combines with a great number of bases, giving us an important class of salts, called nitrates.

When the ashes of plants are examined, we find carbonates of bases that did not exist in the soil as such. A large proportion of carbonate of lime and potash is found in ashes; the origin of these is to be sought in the vegetable acids of plants, which, by heat, produce carbonic acid. This is the effect of heat upon all salts formed of vegetable acids, such as tartaric, malic, citric, oxalic, and vinegar or acetic acids. Each plant forms acids in definite quantity, proportionate to its size, age, and parts of the plant; thus is it beautifully ordered by nature, the acids being constant, the bases to saturate them will be equally constant.

It is an established fact, that plants growing in a soil containing a due mixture of earthy ingredients, always select a due proportion of each, according to their functions, but if in such a soil an excess of either of the alkalies, such as lime, potash, soda, or magnesia, be present, then an excess of either of these bases may be taken up by the plant to the exclusion of the usual proportion of the other; hence, one base may be *substituted for another* in *equivalent proportion*, but through certain elements, may supply the place of others, yet no one element can supply the place of all the others. Nor can the possible mixture of mere silicates and salts alone give fertility to a barren soil. Fertility depends, in a great measure, upon the presence of vegetable matter in the soil. This vegetable, or organic matter, is constantly undergoing changes, and this chemically induced change exerts a powerful influence upon fertility.

In the products of the decomposition of organic, or vegetable matter, a variety of substances is formed, differing according to circumstances, the time and progress of decay. In this decomposition of vegetable matter in the soil, the nitrogen it may have contained combines with hydrogen, a *highly important fact to be remembered.* This union of nitrogen and hydrogen produces *ammonia.* The nitrogen of the putrifying body is thus converted into ammonia, and there remains the several forms of "humus," or vegetable mold.

The elements which do not usually enter into the constitution of animal or vegetable matter, mostly from comparatively simple compounds; while the four "organic" elements—carbon, oxygen, hydrogen, nitrogen—though few in number, form an immense number of compounds of great complexity, Hence, the moment life departs, the animal or plant speedily undergo new changes; its elements which life had organized, obey now not the laws of life, but the laws of chemistry. The solids and fluids of a living body escape part in air and gas, leaving a solid mass differing equally from any living organic product, and form inorganic elements. This complexity and susceptibility to decomposition of inorganic or vegetable bodies, is a great practical fact in agriculture. It is this that forms the humus, or vegetable mold, which imparts fertility to soil.

The great practical lesson of all agricultural experience teaches, that humus or mold, is essential to the healthy growth of plants, and the perfection of seed, that without *humus*, crops *cannot be made.* So far as nourishment is derived from the soil, mold or humus, with mineral salts, is the food of plants. *It may be laid down* as a principle in agricultural chemistry, *that humus,* in some form, is absolutely *essential to agriculture.*

HUMUS OR VEGETABLE MOLD.

Humus, or mold, is the product of decomposition of bodies once endowed with life. For the present purpose, it may be considered as the result of vegetable decomposition. Life, and the manner how plants grow, may not be understood. Growth is a process of life. Decay is a chemical process The laws of decomposition are not only understood, but its products may be limited, controlled and hastened. Decay is fermentation, and this, marked by its several stages, ends in putrefaction. Putrefaction is the silent onward march of decay. Its end is *humus or mold,* the great promoter of fertility.

The union of hydrogen and nitrogen, as before said, *forms ammonia.* This ammonia, which always exists in the air, by the action of the oxygen of the air, becomes nitric acid. *These are facts.* Ammonia in the air, in contact with porous vegetable matter in a decaying condition, becomes *aqua-fortis*, or nitric acid. Moist decaying substances induce the nitrogen of the air, inclosed in their pores to become first ammonia, then nitric acid. There is a constant formation of nitric acid in the decomposition of vegetable matter. What becomes of the nitric acid? It forms nitrates, a class of salts of great value in the soil. All these changes are worthy of study; the ultimate results are the formation of water and carbonic acid; the intermediate products are ammoina *nitrates* and soluble salts in the soil, essential to the growth of plants.

Hence the necessity of the presence of *humus* or mold in the soil. No practical farmer ever had other opinion than this, that decaying vegetable matter in soil (matter in active state of decay), is essential to good crops. It may be assumed that science has now shown the specific grounds for this universal belief. It is perfectly useless for a farmer to spend time and money in putting lime, potash and *other* salts on his land, when there is no vegetable matter in the soil. This *fact* well understood will save thousands of dollars every year.

CHAPTER V.

THE MUTUAL ACTION OF THE ORGANIC AND INORGANIC ELEMENTS OF THE SOIL.

We will now take up and study the mutual action of the organic and inorganic matter in thesoil. How do the elements of the soil act? The answer involves two important considerations. First, the mutual chemical action of the elements of the soil, the vegetable matter and salts upon each other; and, second, this action, as influenced by the living, growing plants.

The elements of the soil are *silicates*, salts, and humus, or vegetable mold. The silicates are such as have no tendency to act upon each other; these are gradually decomposed by the action of the air. The great agent in this action is carbonic acid, which gradually combines with the alkaline base of the silicates, and the potash and soda in them are converted into *soluble salts*, while the sand and clay remain. The result of this action is that the plants are enabled to take up by their roots the soluble salts which have been set free, and the soil becomes more clayey.

If lime be applied to land, either air-slacked, shell or marl, the result is, slowly but surely chemical action takes place, resulting in rendering soluble an additional supply of nutritive ingredients, such as potash, soda, phosphoric and silicic acids, from the previously undecomposed minerals in the soil. Thus, clay soils are benefitted by liming, and also sandy land, if not limed too frequently and in too large doses. It may be laid down as a principle that carbonic acid and ammonia decompose the earthy, alkaline and metallic silicates in the soil. The result of this action is that lime, potash, soda, magnesia, and metallic oxydes are rendered available as food for plants.

Experiments have shown conclusively that the carbon which plants contain, and which forms the bases, as it were of their vegetable substance, is derived from the *air* and *not* from the soil. Plants *can* grow in soils absolutely devoid of vegetable matter, provided the soils contains mineral ingredients required by the plant, in a soluble state, or at least in a condition available to rootlets of plant.

This condition we do not often find fulfilled in soils in their natural state. It has been before stated that only a part of the nutritive ingredients present in the soil is usually available, the greater part being "locked up" in the undecomposed, or partially decomposed minerals, and but very gradually set free by the action of the atmosphere. This very *action* is due chiefly to the carbonic acid contained in the air, and will be the more powerful and rapid, the more carbonic acid is present. Now, carbonic acid is continually formed in the process of decay of vegetable matter; hence the importance of this vegetable matter in the soil. It is true that in some measure it acts as an exhauster of the mineral ingredients in the soil, and in that respect would be injurious if we do not supply annually ashes, phosphate of lime, soda, or stable and barn yard manures which contain them all.

But the "hnmus" or vegetable mold has other highly important offices in vegetable economy. One of these—its *rententiveness of moisture*—it soaks up moisture like a sponge; it serves as a correction for light, sandy soils; while on the other hand it renders clay soils less compact and stiff. Yet there is another virtue possessed by "humus" more important than either of the others—its power of absorbing *ammonia* *from the air*—thus fixing in the soil this important stimulant, as well as nutritive ingredient ready to be taken up by the rootlets of plants.

When we consider the great importance of the properties of "humus" just referred to, it cannot be surprising that its presence should, as a general rule, exercise an influence so decidedly favorable on the productiveness of soils, yet it is incontestably true that "humus" alone, without mineral ingredients, will not support vegetable growth. It is, nevertheless, true that a perfectly healthy growth of cereals or any useful cultivated plant is rarely attained in soils destitute of "humus." Hence the necessity of composting mineral ingredients with vegetable mold or humus.—[*Professor E. W. Hilgard, West of Mississippi.*

The mere presence of growing plants of roots, of seeds where life is, impresses upon both the vegetable and mineral elements of the soil power to enter into new combinations. The soil then is not external to plants; so far as life is concerned it is as much *internal* as if the plant had a mouth and stomach through and into which the soil might be fed. Call this power life, electricity, galvanism or by any other name, still the great fact remains, that the mere presence of a living, growing plant in the soil effects a greater amount of decomposition than all the other influences. This fact is of the highest importance in practical agriculture.

It is this decomposing action of the living plant on the mineral elements in the soil which affords the only reasonable explanation of the action of the salts in agriculture. This *power* of life dissolves the elements of the salts; they enter into new combinations, the base and the acid being often separated by the action of the living plant.

We will illustrate this action: Suppose there be applied to the soil a salt composed of muriatic acid and soda (which is common table salt). By the action of the living plant this salt is partially decomposed, that part of the soda furnishes direct food for plants, and the rest with the muriatic acid acts as solvents in the soil, and in that way nourishes vegetation. But the farmer should distinctly understand that large crops, resulting from the use of salt, is at the expense of his soil. Therefore salt should only be used in small quantities, and always composted with other manures.

Again, let us take another illustration: Suppose sulphate of lime (land plaster, or as it is generally known, plaster of Paris), be applied to the soil, the effect of only one bushel per acre is wonderful to behold on clover or grass lands, which shows its good effects as far as the eye can reach. It is almost incredible that so small a quantity could act at all, yet how beautifully is it explained by the principle that plants dissolve this salt, the *lime* is separated from the *sulphuric acid*, both of which are direct food for plants; yet its supplying these ingredients to the soil is but rarely the main cause of its good effect upon crops. It has a great attractive power for ammonia and carbonic acid contained in the air, both of which it attracts and *fixes* in the soil. The lime, carbonic acid and ammonia act as solvents of the silicates in the soil, and the potash, soda, etc., of the silicates is liberated to become food for plants.

There is no speculation, and we may say no mystery, as to the manner in which these ingredients of the soil act. The effect produced by such wonderfully small quantities of the mineral fertilizers is no longer astonishing. It is no more wonderful than that *leaven* should make *dough rise,* it is even less mysterious.

CHAPTER VI.

MINERAL FERTILIZERS—THEIR ACTION IN THE SOIL.

Silex or sand, lime, potash, soda, magnesia, iron, sulphate, phosphorus, Chilian saltpetre and salt are the mineral parts of plants. It is mainly with these substances we have to deal in connection with fertility in agriculture.

"SILEX."

Silica or silex is a very abundant natural product. It forms a large part of all granite or primitive rocks, and is the chief ingredient in sand stones earthly formations, rock crystal or quartz. Flint and substances of this kind are composed almost entirely of silex or sand. Silex, in the form of sand, is the principal article used in the manufacture of glass. Oxygen with silicon, forms silicic acid (as before explained). This acid uniting with bases forms silicates, as the silicate of potash, silicate of lime and of soda. Silex in the form of sand is the principal part of all soils.

LIME.

The purposes served by lime as a chemical constituent of the soil, are, at least, of four distinct kinds, viz:

1. It supplies direct food for plants which appears necessary for their healthy growth.

2. It neutralizes acid substances, which are naturally formed in the soil, decomposes and renders harmless other noxious compounds, which are very often in reach of the rootlets of plants.

3. It changes *insoluble* vegetable matter into soluble food for plants.

4. It promotes the decomposition of existing compounds in the soil, so as to prepare them more speedily as food for plants.

Lime is not merely a *base*, but a very strong base, and can therefore withdraw from the weaker bases existing in the soil the acids with which they are combined. Caustic or quick lime, as the name indicates, attacks the skin of the hand, and dissolves it in washing in the same way as potash or lye, and has a similar action upon other animal and vegetable substances. When lime is mixed with the soil, it acts in this decomposing and dissolving way upon leaves, straw, stalks and other vegetable matter in the soil which have already been partially converted into mold by natural decay.

The difficulty of vegetable matter in light soils, accounts for lime not acting beneficially. It should be used very sparingly on such lands, and with an interval of six or seven years between the limings. Let green crops of peas or clover be plowed under, on such soils, and then limed. The farmer will find his grain crops greatly increased, and his land left in better heart.

Quick-lime should never be used with "*guano*," stable or fermenting manures; it has the effect of setting the *ammonia free* in these manures. After the lime has been sometime on the surface of the soil, it can exercise no injurious effect on any kind of manure.

The most valuable kind of lime for agricultural purposes, is that obtained from burning oyster shells, and allowing it to remain exposed to the air a few hours to slack. The amount used to the acre, depends upon the nature of the soil, from thirty to one hundred bushels; thirty bushels on the light, and one hundred on the clay lands.

GYPSUM—SULPHATE OF LIME, OR PLASTER.

Gypsum, or the sulphate of lime, is a well known white, crystalline compound, found in large deposits, in various parts of the world. The native plaster, or gypsum, of commerce, consists of:

Water	21 per cent.
Lime	33 " "
Sulphuric acid	46 " "
	100 parts.

A ton of pure plaster will yield when ground, about twenty-five bushels. Dr. Benj. Franklin, when he wished to introduce this fertilizer into America from France, in order to convince his countrymen of its efficacy, sowed in large letters upon a clover lot, at Washington city, in powdered plaster, this phrase: "*This land has been Plastered.*" The effect of this application of plaster was distinctly visible for several years.

The soils upon which plaster has the most marked effect, are those of a light, dry and sandy nature. It is used principally on grass and clover crops, with great success, one bushel of plaster often doubling the crop. But in order that such a simple substance as gypsum, should be of benefit, the soil must possess all the other ingredients necessary for a crop. Take clover, for an illustration. This plant requires fourteen substances to perfect its growth, if only one of these substances be missing, as *potash*, for instance, the other ingredients would be of little, or no avail.

On land exhausted by over-cropping, which contains very little vegetable matter, plaster will be of no service, but will do good after an application of barn-yard manure, or the plowing under of a green crop. Plaster may be applied to grass lands by sowing it broad-cast, at the rate of one to two bushels per acre; it may be applied in the hill to beans, peas, or corn, at the time of planting, or dropped upon them just after they are up. The best time for applying plaster, is in the morning or evening, when the dew is upon the plant, or on a damp, cloudy day.

When sown with grain, the ordinary dose is equal in bulk, to that of the grain, say two hundred pounds to the acre, but to crops of potatoes and corn, as much as three or four bushels have been applied. Used in a compost with dung, or combined with other manures, such as guano, it has a marked effect upon turnips. If plaster is sprinkled over barn-yard or stable manure, it hastens decomposition, and at the same time *fixes* the *ammonia*, so that it cannot escape into the air and be lost.

MARL.

By the term, "marl," is generally understood an earthly mixture, containing not less than one-fifth of its weight of lime, or twenty per cent. of the carbonate of lime.

"*Clay Marl.*"—This has the appearance of a more or less tenacious clay. When long exposed to the air, or put in water, crumbles to powder. It has much the same qualities of lime, and acts in a similar manner in soils, but with less energy. Clay marl usually contains sixty-eight to eighty per cent. of clay, and from twenty to thirty-two per cent. of lime.

"*Stone Marl.*"—Is often richer in lime than the clay. Clay marls are sooner dissolved than the stone, and commonly have stronger power of neutralizing acids, and producing salts. Clay or stone marls are well suited to light, sandy soils, which they improve and render more solid. On the contrary, sandy marls are good for stiff, clay soils, causing them to be easily worked.

"*Shell Marl.*"—This marl is different in nature from the two just described, being highly fertilizing upon soils of every description. It does not disintegrate in water like them, but sucks it up, and sometimes swells like a sponge, as they do. It contains from thirty-two to forty-six per cent. of lime, and dissolves quickly when exposed to the atmosphere. Most of the marls above described, are to be found in great abundance in the Southern States. From five to six hundred bushels to the acre should be applied, or about twenty wagon loads.

Many marls contain green sand-grains, a mineral containing a large quantity of potash and soluble sand, and therefore especially adapted to the cereals and grasses.

POTASH.

Potash of commerce, is obtained from the lye of wood ashes, boiled down in pots; hence, the name of potash. It is used chiefly in the manufacture of soap and glass. Ashes of wood are used largely in agriculture; one bushel of good wood ashes, contains about four and a half pounds of pure potash.

ANALYSIS OF ASHES (100 POUNDS) OF BEECH AND PINE WOOD.

	(Bottinger.) Beech.	(Malaguti.) Pine.
Potash	11.80	16.24
Soda	2.04	5.26
Magnesia	8.42	7.12
Chloride of soda	0.16	1.65
Sulphuric acid	1.01	10.29
Carbonate of lime	47.21	44.74
Phosphoric acid	2.29	6.11
Silica	1.09	5.81
Oxyde of iron	0.60	1.60
	100.00	100.00

It will be perceived from the above analysis, that woods ashes contain an average of about twelve per cent. of potash, three and a half per cent. of soda, five and a half per cent. of sulphuric acid, all soluble in water. The insoluble parts are bases, and when they come in contact with the mold and acids in the soil, *become soluble*, causing the insoluble humus or mold to become soluble, and, therefore, food for plants. Hence, the value of wood ashes as a fertilizer.

SODA.

Soda is readily distinguished from the other alkalies by the following characteristics: With *muriatic* acid it forms *common table salt*, with the taste of which every one is familiar; with sulphuric acid it forms Gluaber's salts, or sulphate of soda. All the salts of soda are soluble in water. When applied to the soil it immediately combines with the acids, and forms soluble salts.

MAGNESIA.

Magnesia is a common substance, existing in most soils. It is a white, light, and odorless powder, and slightly soluble in water. It forms soluble salts with nitric, muriatic, or sulphuric acids. According to "Bergmann," magnesia forms an important ingredient of some of the most important soils, and of the mud of the river Nile, in Egypt. Magnesia is present in almost all soils, in sufficient quantities for plants, and is found in the seeds of most plants. It can be procured in large quantities from magnesian lime-stone, which abounds in various sections of the world.

IRON.

Iron is sometimes found in its natural state, but very seldom. The ores of this metal are very numerous, and some of them very beautiful and interesting. They are chiefly sulphurets and oxydes, but the oxydes are the only ores from which the metal is obtained. Iron combines with carbon, sulphur, iodine, phosphorus, and the different acids. It is present in most all the soils, and is a constituent of the blood of all animals, including man.

SULPHUR.

Sulphur is a well known brittle solid, of a greenish-yellow color. It is chiefly interesting in agriculture from the fact that sulphuric acid is formed from it, thus: 1 comb. wt. sulphur = 16x3 comb. wts. oxygen 24 = 40 sulphuric acid. Sulphuric acid unites with lime, forming the sulphate of lime or plaster, it also unites with other bases, forming sulphates, and it is used to dissolve bones, forming the "*superphosphate of lime.*"

"PHOSPHORUS."

Of all the substances which the farmer has to take under consideration, we think phosphorus the most important. It is found in all animals and vegetables; without it, neither the one nor the other could live. It is also diffused widely, and is discovered in combination with oxygen, in all rocks, in all soils, in all plants, and in the flesh and bones of fish, reptiles, insects, animals, and in their secretions. It is found in nature, combined with many other substances, forming phosphates; thus, we have the phosphate of lime, of magnesia, of iron, etc. But it is in the phosphates and phosphoric acid, that the farmer is most interested.

The use of "bones" in agriculture, has been long and widely adopted in England, and in other countries in Europe, and for some years they have been extensively used in the United States. From 300,000 to 400,000 tons of bones are imported into Great Britain, and used by the English farmers every year. The chief source from which this vast quantity of *bones* is obtained, is from the plains of South America, where great herds of wild cattle are annually slaughtered for their hides, tallow and *bones*.

"Bones" are the most available source from which the phosphate of lime is obtained. Guano owes a large proportion of its value to the phosphate of lime it *contains*. "Bones" enter into the composition of nearly all the artificial manure-powders of commerce. Bones, like guano, *force* and quicken vegetation, develop and form seed.

RAW BONES, SUCH AS HAVE NOT BEEN BOILED OR CALCINED. ANALYSIS OF 100 POUNDS OF BONES, BY HENITZ.

Fat, gelatine and water	23.42
Phosphate of lime	63.62
Carbonate of lime	7.89
Magnesia (phosphate)	2.28
Soda	2.79
	100

No practical use can be made of bones, until crushed or ground—the finer ground the better. When finely ground, if moistened, the meal soon heats, fermentation sets in, and the gelatine evolves from four to six per cent. of its weight as pure ammonia. To prevent the escape of the ammonia into the air, sprinkle the pile with a few pounds of plaster, or with one-half pint of oil of vitrol (sulphuric acid), stirred into two gallons of water, for every one hundred pounds of bone meal.

"Boiled bones," such as have been boiled at soap factories, for the purpose of extracting the fat and gelatine, or have been boiled, so that they can be crushed or ground more readily:

ANALYSIS OF BOILED BONES, (100 PARTS).

Water	10.
Animal matter	20.2
Phosphate of lime and magnesia	65.5
Carbonate of lime and magnesia	8.3
	100 parts.

Practical experience has demonstrated that bone meal from boiled bones, is its most valuable form for agricultural purposes, chiefly on account of the very fine state of division. The bone meal ferments, some ammonia is given off, the phosphate of lime combines with the animal matter, and is easily dissolved by rain water.

CALCINED BONES OR BURNED BONES, SUGAR-HOUSE REFUSE, OR BONE-BLACK.

Bones are easily reduced to the state of ashes, by piling them up with light-wood or faggots and firing the heap. The bones continue burning until reduced to whiteness, become as brittle as pipe stems, and are very easy to grind. By this mode, all the animal matter is burned out. In the state of ash, phosphate of lime is less soluble than bone meal; hence, does not act as quickly, nor mature a crop as rapidly as the latter. It has been found by treating bone ash, as also bone meal, with certain acids, the phosphate of lime is brought into a highly soluble state. The cheapest acid, and the one commonly used for this purpose, is sulphuric acid or oil of vitriol; which produces by its action on bone, both plaster and a soluble phosphate of lime, called super-phosphate of lime. In this state, bone acts quicker and goes farther than in any other form.

There are various methods of dissolving bones with oil of vitriol (sulphuric acid). It should be borne in mind that this acid is highly corrosive, and requires great care in handling it, or the hand may be burned, an eye lost or clothes destroyed.

First method. Take one hundred pounds of crushed bones—the smaller the better—place them in a hogshead, pour upon them five or six gallons of water, so as to thoroughly wet them. Then pour in carefully, thirty-three pounds of acid, stir the mess with a wooden shovel until the acid comes in contact with all the bones; cover up and let it stand twenty-four hours. Then give the second dose of thirty-three pounds of acid, stirring the mess well; cover up the hogshead and let it stand for ten or twelve days, when you will find the bones dissolved.

Second method—without acid. Take broken bones—the smaller the better—place them in a hogshead or barrel in a layer of six inches, then a layer of hard-wood ashes, mixed with one-tenth of its bulk of slacked lime, so as to fill the spaces between the bones, and cover them; proceed in the same way, until the barrel is nearly full. Then pour in boiling-hot water enough to wet the whole mess, cover up and let it stand for from thirty to forty days, taking care that the lye does not leak out, but remains standing over the ashes. This preparation will not act as quickly on vegetation as that prepared with the acid, but will answer a very good purpose.

Third method. If the bones be ground fine, by using a larger proportion of acid, say eighty-six and one-third pounds to the one hundred pounds of bones, a superphosphate will be formed, which will act very quickly, and have almost the same effect as the best Peruvian guano.

Fourth method. If the bones be ground to a fine meal, by using a smaller portion of acid, say twenty-eight pounds to one hundred pounds of meal, a superphosphate will be formed, which will act more slowly, but last longer than the above.

By pursuing either of the above methods, phosphate, or the superphosphate of lime, will be produced, which will act very beneficially in forcing vegetation with all crops, and especially in forming the seed. A special mixture of guano and superphosphate of lime has been described before for crops of corn, cotton, wheat, etc.

CHILIAN SALTPETRE AND COMMON SALT.

Among the stimulants which may sometimes be used to advantage, both by themselves and in addition to stable manure or to the compost pile, we may mention *common salt* and Chilian saltpetre, or nitrate of soda. They act as solvents and decomposing agents, somewhat in the manner of ammoniacal salts, and the farmer ought to *understand* distinctly, that large crops, resulting from their use, have been produced entirely at the expense of his soil. Both salts, being but slightly absorbed by the soil, are soon removed from it, to a great extent, by drain water.

COLUMBIAN GUANO.

There is imported from South America, under the appellation of "Columbian Guano," a substance very different from the Peruvian article, which consists chiefly of *phosphate* and carbonate of lime, but it contains no ammonia, or only traces of it. It may be used in the same way as ground bones, or superphosphate of lime; it is not, however, as energetic in action as the latter, being much less soluble.

It has been attempted, and apparently with considerable success, to remedy the slowness of action by intermixture of the finely ground mineral with *stimulants*, such as Peruvian guano, or *ammonical salts.*

CHAPTER VII.

AN ADDITIONAL DESCRIPTION OF MINERALS.

To have a clearer understanding of the facts, illustrations and experiments presented in this work, the author thinks it necessary to give a more extended description of the minerals and acids.

QUARTZ.

Quartz is silica crystalized. When broken down into fine grains, it forms sand, and this consolidated or concentrated with silex, lime or oxydes of iron, constitutes sand stones. When silica is fused with bases it unites with them, playing the part of an acid, and forming salts—the silicates.

Talc and Serpentine.—Talc is the silicate of magnesia. French chalk and soapstone are varieties of talc, and are so soft that they may be worked with the same tools as wood. Soapstone does not fracture in the fire, and is used for lining fire places and grates. It has a soapy, greasy feel, hence its name.

Augite.—Augite is a double silicate of magnesia and iron, its prevailing color is some shade of green. It forms extensive barren ridges of magnesian rock.

Horneblende.—This mineral is the silicate of magnesia, iron and lime. It is of a dark color, and exists abundantly in many rocks which yield lime to soils when decomposed. It is an element of the slate and trap rocks.

Feldspar.—Feldspar contains a large proportion of clay. It is the chief ingredient of porphysy, the hardest and most enduring of all rocks. It is a white or flesh-colored mineral, and by decomposition furnishes potash and clay to soils; also, the fine clays for porcelian ware.

Mica.—Mica occurs in semi-transparent plates, which may be split into elastic leaves of almost any degree of thinness. It withstands fire, and is used as a substitute for glass in the doors of stoves. It is frequently called isinglass. Quartz, feldspar and mica compose granite, which underlays all other rock formations. Much of the Rocky Mountains, Andes Alps, Pyrenese and all the highest mountains in the world *are granite.* Upon many of the "silicates" the *air* exerts a destructive agency. The carbonic acid of the air slowly unites with their bases, thus breaking the bond which united their elements, and combining with them. By absorbing into their pores moistures which expands when freezing, they are mechanically crumbled down. These joint forces are constantly active in disintegrating and wearing down rocks and stones, and reducing them to the condition of *soil.*

ARTIFICIAL SILICATES.

Although not immediately connected with agriculture, yet it may not be uninteresting to mention some of the artificial silicates:

Glass.—The several kinds of glass are *composed* of *silica* or *sand*, with various bases. Silicate of potash and soda forms a colorless glass which is *soluble* in water. This *soluble* glass is applied to wood and cloth, etc., to render them incombustible. Silicates of *soda and lime* forms window glass, the soda gives it a slight greenish tinge. The lime hardens the glass and adds to its lustre.

Silicates of potash and lime forms *plate glass* and crown glass (the finest window glass).

Silicates of potash and lead yield *flint glass* and crystal glass. The oxyde of lead gives it great transparency, brilliancy and refractive power; it is hence used for chandiliers and optical lenses.

Silicates of alumina, of oxyde of iron, and potash or soda produce green bottle glass, the color being due to the impurities of the materials.

Earthenware.—Silicate of *alumina* or clay is the basis of all the varieties of pottery. Its adaptation for this puroose depends upon its plasticity when mixed with water, the readiness with which it may be molded and shaped, and on its capability of being hardened when exposed to a high heat in furnaces or kilns.

ACIDS.

Some more extended explanation of the acids may be necessary, we therefore lay them before the reader:

Carbonic Acid.—This acid being one of the most important, we will describe it first. Carbon unites with oxygen in the proportion of one combining weight to two, forming carbonic acid (c. o. 2). Carbonic acid is a colorless gas, with a slightly sour taste, and is about one and a half times heavier than *air.* It exists abundantly in the mineral crust of the earth, *hence called fixed air;* and is found also in the atmosphere in a pure state. It is found in lime stone to the extent of forty-four per cent. of its weight, and is best obtained by the action of *muriatic acid* upon powdered *marble.*

Any strong acid will do. A cubic inch of marble will yield *four gallons of gas.*

Properties of Carbonic Acid—It Extinguishes Fire.—A candle dipped into it goes out at once, and if poured upon a flame it quenches it as quickly as water. It is *the foul air in wells;* hence no one should venture into a well before testing whether carbonic acid gas is present or not. A candle let down in the well is a good test; if extinguished the gas is present, if it burns as usual there is no danger.

Sources of Carbonic Acid.—Carbonic acid is produced very abundantly in nature. The burning of wood (which always contains carbon) in the open air yields it in vast quantities. The combustion of one bushel of *charcoal* will produce two thousand five hundred gallons of this gas. It is formed within the bodies of all animals, by the union of the oxygen of the atmosphere with the carbon contained in the system; it escapes through the lungs, by respiration, into the *air.* Each adult man exhales about one hundred and forty gallons per day.—[*Davy.*

The test of carbonic acid is clear lime water, which it turns milky, by forming insoluble carbonate of lime. To prove that it is the product of both combustion and respiration, invert an empty jar over a burning candle for a short time; then agitate in the jar a little lime water. It will *become turbid* at once. With a glass tube, or a tobacco-pipe, breathe through a portion of clear lime-water, and the same effect will be produced.

Carbonic acid exists in all natural waters, and form many mineral springs, as those at Saratoga; it constantly escapes, causing the water to sparkle, and giving it a pungent, lively taste. Soda-water is such as has been charged artificially with carbonic acid.

Its Physiological Effects.—Carbonic acid gas, when respired, destroys animal life. This it does in two ways: when breathed pure it produces spasms of the glotis, closes the air passages, and thus kills suddenly by suffocation. When diluted with even ten times its bulk of air, and taken into the system, it acts as a narcotic poison, gradually producing stupor, insensibility and *death.*

Persons sleeping in close apartments are sometimes suffocated by the fumes of burning charcoal—*carbonic oxyde*—as already stated above, but so many persons are killed by going into wells that I state it again. It often accumulates at the bottom of wells and in cellars, stifling those who may unwarily descend. To test its presence in such cases, lower a lighted candle into the suspected places. If it is not extinguished, the air may be breathed for a short time; if the light goes out, it will be necessary before descending, to throw down some dry, slacked lime or raise and depress an umbrella in it repeatedly, in order to mingle it with the air.

To resuscitate those who have been exposed to the poisonous action of carbonic acid, dash cold water upon them freely, rub the extremities, and, if the body is cold, administer a warm bath.

Carbonic acid is used to suffocate insects, as butterflies, when it is desired to preserve the colors perfect. The Lake of Averno, which was asserted by the ancients to have been the entrance to the *infernal* regions, evolves so large a quantity of carbonic acid gas, that birds flying over it drop from suffocation. Carbonic acid unites with bases forming a class of *salts*—the *carbonates.*

Sulphuric Acid.—This powerful acid is of the greatest interest to the chemist, agriculturist and manufacturer. It was formerly obtained from "green vitriol," and hence called "*oil of vitriol.*" It is now prepared upon a large scale, by heating sulphur and nitre in furnaces and conducting the sulphurous and nitrous acid fumes which are thus formed, into vast leaden chambers, along with steam and atmospheric air, the floor of the chamber being covered with water. The water at the bottom of the chamber, which soon becomes very acid, is drawn off and boiled down in platinum stills to a sufficient degree of concentration.

When the acid is procured from the distillation of green vitriol, it comes off in a dry state, and attracts moisture so rapidly as to cause fuming; it is hence called the fuming oil of vitriol or "Nordhousen acid," because it was largely manufactured in a city of that name in Saxony. Common sulphuric acid or oil of vitriol, contains a larger proportion of water.

Properties.—Sulphuric acid has a thick, oily appearance, with a greasy or soapy face; but it speedily corrodes the skin, and causes an intense burning sensation. It has a powerful affinity for water; when a splinter of wood is dropped into it for a short time it "chars" or turns black, the acid decomposing it into water and carbon. In like manner it decomposes the skin, and most organic substances, by removing their water. It is an active poison, the best antidote being copious draughts of *water and chalk*, or the carbonate of soda or magnesia.

Uses.—Sulphuric acid is extensively used in the manufacture of soda from common salt; also in the manufacture of chlorine for bleaching; of citric, tartaric, acetic, nitric and muriatic acids, sulphate of soda, sulphate of magnesia; also dyeing, calico printing, gold and silver refining, and in purifying oils and tallow. Its chemical uses are innumerable. It is the Hercules of the acids. Its uses in agriculture have been before stated.

This acid unites with *bases* forming the *sulphates*, and exists in nature both combined, as with *lime* in sulphate of lime, or gypsum, *and free*, as in some streams of water and springs, the water of which it renders acid. It is nearly twice as heavy as water, a gallon weighing thirteen pounds. The test for sulphuric acid is the chloride of barium, with which it forms an insolube precipitate.

Phosphoric Acid.—Phosphorus has an intense affinity for oxygen. Place a bit of phosphorus, of the size of a pea, in a wine glass; cover it with hot water, and direct against it a current of oxygen gas, it will burst into violent combustion beneath the surface of the water. *When a match is burned*, the white smoke that appears is phosphoric acid; it is always produced when phosphorus is burned in dry air or oxygen gas.

This acid condenses into solid white flakes of snowy appearance, and possesses a powerful affinity for water, hissing like red-hot iron when brought in contact with it.

Phosphoric acid is of the highest importance in agriculture. It is principally from its presence in bones that they are useful as a manure. There are three other compounds of phosphorus and oxygen, but they are of interest only to the scientific chemist.

Nitric Acid or Aquafortis.—This acid is the most powerful of the chemical compounds of oxygen and nitrogen. It is prepared by distilling equal weights of *sulphuric acid* and saltpetre. Pure nitric acid is a colorless liquid, one-and-a-half times heavier than water. It smokes when exposed to the air, and is partially decomposed by the action of light, *nitrous acid* being formed, which gives it a yellow color. It has an intensely acid taste, and reddens vegetable blues. It is used for etching on copper, for assaying or testing metals, and as a solvent for tin by dyers and calico printers. It is also used as a medicine, as a caustic to cleanse and purify foul ulcers. In consequence of its large proportion of oxygen, it corrodes or rusts metals with great energy, and hence it is a most powerful oxydizing agent.

Nitric acid occurs in small quantity in rainwater, especially after thunder-storms, and is thought to be produced in the air by lightnings, which combines the gaseous nitrogen and oxygen, and also by the oxydation of ammonia in the air. It is found in nature in combination with the *alkalies and earths.* Combined with *potash or soda,* nitric acid is a valuable fertilizer. It hastens and increases the growth of plants. It also occasions a larger produce of grain, and this grain, as when *ammonia* is employed, is more nutritious in its quality.—[*Professor Jackson.*

Ammonia (*Volatile Alkali*).—Three combined parts hydrogen and one combined part nitrogen form ammonia. It is a gas, colorless, irrespirable, of a pungent, caustic taste, lighter than air, and possesses strong alkaline properties, neutralizing acids and changing vegetable yellows to brown. Being a gas, it is called *volatile alkali*, to distinguish it from those that are fixed or solid. The great source of the ammonia of commerce is the liquor of the gas-works.

Ammonia is used medicinally in various ways. It is administered internally as a powerful stimulant, and applied externally as a counter-irritant.

Ammonia is one of the most active ingredients of manure. It is produced by the putrefaction of all vegetable and animal substances containing *nitrogen.* The *urine* of animals evolves it in large quantities. If this be be collected in tanks, and sulphuric acid (oil of vitriol) added, fixed sulphate of ammonia is formed in the liquid, and all the ammonia is thus saved for farm use. Sulphate of lime (plaster) and sulphate of iron (green vitriol) also serve to fix ammonia. As the decomposition goes on, which forms ammonia, carbonic acid is also generated, which unites with the former, forming the carbonate of ammonia; it exists in this form in the atmosphere.

The application of ammonia increases the luxuriance of vegetation and hastens the maturity of crops. It enters the roots of plants dissolved in water, and, according to Liebig, is absorbed by leaves from the air.

Silicic Acid—(*Silica, Sand*).—However strange it may seem that such substances as sand and flint should be classed among the acids, yet *such is the fact.* At high temperatures, silica exhibits powerful acid properties, and neutralizes bases, forming a class of salts—*the silicates.* Most rocks and minerals are silicates.

Although common quartz and sand are totally insoluble in water, yet they are rendered soluble by the action of the alkalies; hence the reason for applying potash and lime to soils to dissolve their silica. When liberated from its combinations by the agency of the air, it is soluble in water; hence it is always present in springs. Silica is necessary to the growth of vegetation, and exists abundantly in many plants; particularly in the stalks of grains and grapes. It is this which gives stiffness to their stems, as the skeleton does to the bodies of animals. If there is a deficiency of *soluble* silica in the soil, the grain stalks will be weak, and liable to break down or *lodge.* How necessary, then, to apply substances which will dissolve silica or sand.

CHAPTER VIII.

ANIMAL AND VEGETABLE MANURES.

Animal maures are compounds of vegetable matter and salts. They, of course, contain all the elements of fertility. The immense variety of substances used and commended for manures, would seem to render the subject both extensive and complicated. It is capable of simplification.

First, let us take up cow manure. Although not as rich as other animal manures, yet it acts very beneficially on all soils. According to the analysis of "Dana," a cow forms daily about thirteen pounds of undecayed vegetable matter, three ounces phosphate of lime, two ounces of plaster of paris and two ounces carbonate of lime; or in one year four thousand eight hundred pounds of vegetable matter, seventy-one pounds of bone-dust, forty-seven pounds of lime, forty-seven pounds of plaster, twenty-five pounds of common salt, and fifteen pounds of sulphate of potash. But from the decay, four thousand eight hundred of well masticated vegetable matter, there is evolved about one hundred and seventy-nine pounds of ammonia, if it is carefully preserved. It is evident, then, that the cow is a great manufacturer of humus, salts and ammonia. The main value of the cow manure depends upon its vegetable matter and ammonia; the other salts are valuable, for they are in such a condition as to be readily taken up by plants. Ammonia in dung is that organic body to which is to be attributed its chief enriching quality. The humus or mold, ammonia and salts, each act; the acid in the mold acts upon the salts, such as lime, potash, soda, etc., already in the soil, and also absorbs ammonia from the air, and forms carbonic acid in its decay. The ammonia acts upon the silicates in the soil, the salts act in a similar manner, and also sometimes neutralize the injurious acids in the soil.

Stable or horse manure is highly valued by farmers, and for good reasons—it is a powerful fertilizer. But the readiness with which it undergoes fermentation, and sends off ammonia, makes it necessary to exercise great care in its collection and preservation. It has the same constituents as cow manure, but in a more concentrated form, and with a much larger proportion of phosphate of lime. It acts in a similar manner in the soil.

The "urine" of the horse is a still more powerful fertilizer, and is generally neglected by farmers. It would pay to make plank floors, so as to collect the urine, but they are injurious to the animals. The most common and practical method adopted by farmers is, to litter their stalls with leaves, saw-dust, mold or swamp-muck. These substances absorb the urine and retain its ammonia or nitrogen. Horse dung heats very quickly, and should therefore be piled in such a manner as to receive at any time a layer of woods-earth or mold and plaster. The plaster not only "fixes" the ammonia in the manure, but eats up the straw, leaves, and rough litter. A sprinkling of plaster to every layer of manure of a foot's thickness is sufficient.

Hog-pen manure is even more valuable than that of the horse, on account of the large amount of ammonia-producing materials in it, and should be preserved with the greatest care. Sheep droppings, on account of the trouble of saving the manure, are very little attended to by farmers. Where a farmer has forty or fifty head of sheep, he can very cheaply fertilize poor spots on his farm by penning and feeding his sheep upon them during the night, for a week or two at a time. In a very short time the spots will become permanently improved.

POUDRETTE AND URATE.

Poudrette is the name given to the human excrements, after being mixed with charcoal-dust or charcoal peat. By these its effluvia is absorbed, and when dried, it becomes a convenient fertilizer for use, and will bear remote transportation. The odor is sometimes expelled by adding quick *lime*, but this removes with it much of the ammonia, and, on this account, should be avoided.

Urate, as well as *poudrette*, has become an article of commerce. It is manufactured in large cities by collecting the urine, and mixing with it one-sixth or one-seventh of its weight of ground gypsum (sulphate of lime), and allowing it to stand several days. The gypsum absorbs a portion of the ammonia in the urine, after which it is dried and the liquid is thrown away. Only a part of the value is secured by this operation. It is sometimes prepared by the use of sulphuric acid (oil of vitriol), which is gradually added to the urine, and forms sulphate of ammonia, which is afterwards evaporated to dryness. This secures a greater amount of the valuable properties of urine.

NIGHT SOIL.

Treatment of Night Soil.—There has recently been introduced into our large cities a method for deodorizing night soils, by the means of what are called "earth closets." These earth closets add greatly to the sanitary condition of the cities in which they have been introduced, and contribute vast quantities of the richest fertilizing ingredients to agriculture: that, too, in a dried, pulverized and portable form, so as to be conveniently applied to the soil.

We have not, as yet, had an opportunity of testing this fertilizer upon crops cultivated at the South; but as it has been used from time immemorial by the Chinese, Japanese, and European farmers, we may take it for granted, a substance which has been heretofore a fruitful source of disease in our cities, will be made a blessing to our country.

With all his industry and efforts, the farmer will find he can manure but a small portion of his farm annually, and a great many contend that making and collecting manures in this way will *not pay.* A fatal error! It will pay to keep one hand and a horse and cart, to do nothing else but haul materials for making manure; this hand would pay better than any other on the farm.

As we said before, the farmer who cultivates a large surface, will have to look to other sources for the largest portion of his fertilizers. This renders it necessary that we should take up and discuss some of the most prominent fertilizers now offered for sale in the markets. First upon the list, we find

PERUVIAN GUANO.

Guano, or huana, which signifies in the Peruvian language, "manure," is now well known to be the excrements of various kinds of sea-fowl, which resort in vast numbers to small uninhabited islands, and rocky promontories, on the coast of Africa and South America, as well as in other parts of the globe. On these islands their excrements have accumulated for ages; in some instances, on the coast of Peru (according to the celebrated traveler Humbolt), to the depth of from fifty to eighty feet.

The Peruvian, or that from the coast of Peru, is esteemed the most valuable, and for good reasons, as there, no or very few rains fall upon the islands from which it is collected, and, therefore, very few of its valuable ingredients are lost. It has been used by the Peruvians, from time immemorial, as a manure, and history tells us the Incas used it before the conquest of Peru by the Spaniards. Humbolt introduced it into Europe, on his return from South America, in 1806; but it was not until 1840 it began to be used as a general fertilizer by the English farmers. At this time, over 300,000 tons are imported into Great Britain, and 500,000 into the United States, annually.

ANALYSIS OF PERUVIAN GUANO—(100 POUNDS).

Water	13.00 =	13	per cent.	Water.
Organic matter	36.00 =	36	" "	Organic matter.
Ammonia	17.00 =	17	" "	Ammonia.
Phosphates	23.50 =	23½	" "	Phosphate of lime, etc.
Alkaline salts	9.50 =	9½	" "	Alkaline salts.
Sand	2.00 =	2	" "	Sand.
	100 pounds.			

Guano, it is hardly necessary to state, from the above analysis, may be applied, with advantage, to almost any kind of soil, and to all the crops we cultivate. It contains all the elements necessary for their growth, with the single exception of mold. One great point to be attended to, is that the land should be in good tilth; otherwise, the tender roots of the plants will meet with obstructions, and become crippled in their growth. Poor, well tilled soils, receive the most advantage from this fertilizer, as they are generally deficient in the very ingredients supplied by the guano.

Taking the best Peruvian guano as a standard, one hundred and fifty to two hundred pounds to the acre, will be sufficient to mature a good crop, mixed with ten times its weight of well rotted woods-mold, muck, or swamp mud. Guano should never be mixed with unleached ashes, potash, soda, or lime, for these salts will "set free" the ammonia, which will be lost in the air, and greatly diminish the effects of the manure.

The action of guano, some farmers contend, while it produces largely increased crops for a few years, finally exhausts the soil. This action results from a kind of stimulating influence which it exerts upon plants, causing in them an artificial growth, by which they take away from the soil more fertilizing matter than the guano has brought into it. This is true, to a certain extent. *Guano* contains nothing which is not real food for plants. It is a well ascertained *fact*, that an ordinary application of guano, gives more mineral matter to the soil than the resulting crop takes away. *But when we remember that guano continues its effects for several successive crops*, the quantity of some of the mineral ingredients of the soil may be diminished. This is especially true of potash, lime, and sulphuric acid. We can guard against this bad effect by using bone-dust and plaster in combination with guano.

The long continued application of guano, will exhaust the mineral matter in the soil. While the guano has an excess of ammonia, it has no humus or mold in it, and as the caustic character of the ammonia hastens the decomposition of the mold, the loss is not made up by the guano, but by mixing *well-leached* ashes, plaster and mold with it, there will be no danger in its application, and a great improvement in the soil will be the reward.

One of the very best methods of applying guano is in connection with green crops of peas, clover, etc., plowed in. It greatly increases the growth of peas, clover, lucerne, etc., and when these crops are plowed under, they add largely to the humus and ammonia in the soil. Guano has the power to act upon the vegetable matter, and convert it more rapidly into humus or mold, than it would have done if the guano had not been applied. It also causes the plants, by increased vigor, to thrust their roots down deeply into the subsoil, and thus bring up an increased supply of mineral matter, in the proper condition to feed succeeding crops.

A great deal of fraud has been practiced in the sale of guano. The best safe-guard against being imposed upon, is to buy only from reliable men, regularly engaged in the business of selling it. One or two simple tests may be useful.

First test. Burn one hundred grains to ashes in an iron spoon or ladle; the remaining ashes should not weigh more than from thirty-five to forty grains, and should be nearly all soluble in dilute *muriatic acid*.

Second test. Rub a little guano with a few grains of freshly slacked lime, and if a strong odor of hartshorn, or ammonia is not given off, the quality is not good.

There are a great many other kinds of guano besides the Peruvian, which have been used very successfully by farmers in the Eastern and Middle States, but it has been the experience of the best farmers, that the pure Peruvian *pays the best*, although the price is higher. The Pacific, Sea-Fowl and Redonda, are all favorably known; while not as rich in ammonia as the Peruvian, they contain a larger proportion of the phosphate of lime, and act very well on crops.

Swamp mud, or well-rotted peat, or woods mold, when composted with guano and the superphosphate of lime, forms a very valuable fertilizer. The farmer can haul, at any time it suits his convenience, the muck or mold, and deposit it upon the wornout spots in his field. When he wishes to manure the land, if he will add guano and superphosphate of lime, at the rate of one bushel of guano and one bushel of superphosphate to twenty bushels of mold, he will have a rich manure. A handful of this mixture in a hill of corn will have a marked effect.

Again: If the farmer mixes one bushel of superphosphate of lime, two bushels of strong wood ashes, and one bushel of lime, with twenty bushels of muck or mold, he will have a valuable fertilizer. Again: If he uses five bushels of ashes and one bushel of lime, with thirty bushels of muck or mold, he will have a good manure. The lime and potash of the ashes acts upon the vegetable matter in the muck or mold, neutralizes the acids in it, and causes quick decomposition of the vegetable matter, converting it into mold.

A great variety of vegetable manures may be formed upon the spots of ground which need them most, if the farmer bears in mind the *principle*, or *fact, that a small amount* of lime, potash, or *soda*, will act upon an *indefinite quantity* of *vegetable matter*, in the compost heap, causing quick fermentation, which ends in the entire decomposition of the vegetable matter.

CHAPTER IX.

USEFUL TABLES FOR FARMERS.

The following table will be useful for readily determining the number of hills, plants, trees, etc., which may be grown on an acre of land:

DISTANCES APART.	NO. PLANTS, ETC., TO AN ACRE.
3 inches by 3 inches	696,960
4 " " 4 "	392,040
6 " " 6 "	174,240
9 " " 9 "	77,440
1 foot " 1 foot	43,560
1½ feet " 1½ feet	19,360
2 " " 1 foot	21,780
2 " " 2 feet	10,890
2½ " " 2½ "	6,969
3 " " 1 foot	14,520
3 " " 2 feet	7,260
3 " " 3 "	4,840
3½ " " 3½ "	3,555
4 " " 1 foot	10,890
4 " " 2 feet	5,445
4 " " 3 "	3,630
4 " " 4 "	2,722
4½ " " 4½ "	2,151
5 " " 1 foot	8,712
5 " " 2 feet	4,356
5 " " 3 "	2,904
5 " " 4 "	2,178
5 " " 5 "	1,742
5½ " " 5½ "	1,417
6 " " 6 "	1,210
6½ " " 6½ "	1,031
7 " " 7 "	888
8 " " 8 "	680
9 " " 9 "	537
10 " " 10 "	435
11 " " 11 "	360
12 " " 12 "	302
13 " " 13 "	257
14 " " 14 "	222
15 " " 15 "	193
16 " " 16 "	170
16½ " " 16½ "	160
17 " " 17 "	150
18 " " 18 "	134
19 " " 19 "	120
20 " " 20 "	108
25 " " 25 "	69
30 " " 30 "	48
33 " " 33 "	40
40 " " 40 "	27
50 " " 50 "	17
60 " " 60 "	12
66 " " 66 "	10

This table can be used also to determine how many piles of manure to a *load*, it will take to spread on an acre, at any of the above distances apart.

TABLES.

The following tables may often be useful to farmers for reference.

Money.—The "prices current" of foreign markets are frequently quoted in newspapers, in accordance with foreign currencies, hence these tables are given.

ENGLISH MONEY.

4	Farthings make 1 penny	= $0.02 1-60
12	Pence make 1 shilling	= 0.24 1-5
20	Shillings (a sovereign) make 1 pound	= 4.84
21	" make 1 guinea.	= 5.10
5	" " 1 crown	= 1.21

FRENCH MONEY.

1	Franc	= $0.18 3-5
5	Franc-piece	= 0.93
1	Crown	= 1.10
1	Napoleon (20 francs)	= 3.85

OTHER FOREIGN MONEY.

1	Florin (Austria)	= $0.48
1	Rupee (Bombay)	= 0.50
1	Thaler (Prussia)	= 0.73
1	Ruble (Russia)	= 0.75
1	Ducat (Germany)	= 2.23½
1	Ducat (Holland)	= 2.27½
1	Doubloon (Mexico)	= 5.53½

Weights.—Avoirdupois weight is used in all business transactions. The long ton, of two thousand two hundred and forty pounds, has generally passed out of use in this country, except at the custom-house.

TABLE OF AVOIRDUPOIS WEIGHTS.

16	Drams	make	1 ounce (oz.)
16	Ounces	"	1 pound (lb.)
25	Pounds	"	1 quarter (qr.)
4	Quarters (100 lbs.)	"	1 hundred (cwt.)
20	Hundred weight (2000 lbs.)	"	1 ton (T.)
56	Pounds of butter	"	1 firkin
56	" of hay	"	1 truss
14	" (an English weight)	"	1 stone
100	" of fish	"	1 quintal
196	" of flour	"	1 barrel
200	" of beef or pork	"	1 barrel
560	" of wheat	"	1 quarter (English)
60	" of wheat	"	1 bushel (United States)
70	" of wheat	"	1 bushel (English)

Measures.—The standard of dry measures in the United States is the Winchester bushel, containing 2150 2-5 cubic inches. A circular measure, eighteen and a half inches in diameter and eight inches deep, holds a bushel.

DRY MEASURE.

2 Pints	make	1 quart
8 Quarts	"	1 peck
4 Pecks	"	1 bushel
5 Bushels of corn (shelled, South)	"	1 barrel
8 Bushels of wheat (English)	"	1 quarter

Liquid Measure.—The wine-gallon is the standard by which liquids are generally bought and sold. It contains two hundred and thirty-one cubic inches.

COMMON OR LIQUID MEASURE.

4	Gills	make	1 pint
2	Pints	"	1 quart
4	Quarts	"	1 gallon
31½	Gallons	"	1 barrel
42	Gallons	"	1 tierce
63	Gallons	"	1 hogshead

LONG OR LINEAR MEASURE.

12	Inches	make	1 foot
3	Feet	"	1 yard
5½	Yards (16½ feet)	"	1 rod, pole, or perch
40	Rods (220 yards)	"	1 furlong
8	Furlongs (1760 yards)	"	1 mile
4	Inches	"	1 hand
6	Feet	"	1 fathom
4	Poles (66 feet)	"	1 chain
80	Chains	"	1 mile
3	Miles	"	1 league

LAND AND SQUARE MEASURE.

144	Square inches	make	1	square foot
9	" feet	"	1	" yard
30¼	" yards	"	1	" pole
40	" poles	"	1	" rood
16	" "	"	1	" chain
10	" chains	"	1	" acre
640	" acres	"	1	square mile

CUBIC, OR SOLID MEASURE.

1728	cubic inches (12x12x12)	make	1 cubic foot.
27	" feet	"	1 " yard.
128	" " (8 ft. long, 4 ft. high, 4 ft. wide)	"	1 cord.
24¾	" " of stone (16½ ft. long, 1½ ft. wide and 1 ft. high)	"	1 solid perch,

A FEW SIMPLE AND USEFUL RULES.

I. *To calculate simple interest at six per cent.*—Multiply the *dollars* by *half* the number of *months*, and the result will be the *interest in cents.* For odd days, *multiply* the *dollars* by the *whole* number of days, and *divide* by sixty—the result will be the *interest in cents.*

For any other rate of interest, as seven or eight per cent.—Multiply the *dollars* by the *rate per cent.*—the result will be the interest for *one year in cents.* This, divided by twelve, is the interest for *one month.* The interest for *one month*, divided by thirty, gives the interest for *one day.* From these, the interest for any period may be calculated.

II. *To determine how many bushels a given space will hold.*—Multiply the length, width and depth, measured in feet. This will give the contents in cubic feet. Now, as there are two thousand one hundred and fifty cubic inches in a bushel and one thousand seven hundred and twenty-eight in a foot, these numbers stand (nearly) to each other as four to five. Hence, multiply the cubic feet of the given space by four and divide by five, will give the bushels (very nearly).

Example.—A crib eight feet long, five feet wide, and six feet deep, contains $(8 \times 5 \times 6) = 240$ cubic feet, then $240 \times 4 = 960$ cubic feet, which, divided by five, gives one hundred and ninety-two *bushels* as the contents of the crib, very nearly.

EXPLANATION OF TERMS.

Absorb—To soak up a liquid or gas, to take substances from the air, or from watery solutions.

Abstract—To take from.

Acid—Sour, acrid; a sour substance.

Agriculture—The art of cultivating the soil.

Alkali—The direct opposite of an *acid*, with which it has a tendency to unite, neutralizing.

Alumina—The base of clay.

Analysis—Separating into its primary parts any compound substance.

Carbonate—A compound, consisting of carbonic acid and a base (metallic oxyde).

Caustic—Burning.

Chloride—A compound containing chlorine.

Decompose—To separate the constituents of any body from their combinations; to decay or rot.

Digestion—The decomposition of food in the stomach and intestines of animals. (Agricultural.)

Fermentation—A kind of decomposition.

Gas—Air; aeriform matter.

Ingredient—Component part of any substance.

Inorganic—Mineral, or earthy; not organized by animal or vegetable life.

Mulching—Covering the soil with litter, leaves, or straw.

Neutralize—To overcome or destroy the properties or effects of.

Organic matter—That kind of matter which possesses or has possessed *life*.

Oxyde—A compound of oxygen with an element.

Phosphate—A compound of *phosphoric acid* with a base.

Pungent—Sharp ; acrid.

Putrefaction—Rotting.

Saturate—To fill the pores of any substance, as a sponge with water, or charcoal with ammonia.

Silicate—A compound of silicic acid with a base.

Soluble—Capable of being dissolved in water.

Saturated Solution—One which contains as much of the foreign substances as it is capable of holding.

Sulphate—A compound of sulphuric acid and a base.

Vapor—Moist air—see gas.

END.

Errata.

On page 19, first line, *germs* should read *gums.*

On page 34, eighth line, *Phosplic* should read *Phosphoric.*

On page 111, second line, *Planting in* should read *Plowing in.*

On page 212, first line in last paragraph, *difficulty* should read *deficiency.*

On page 145, twentieth line, *congulated* should read *coagulated.*

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