



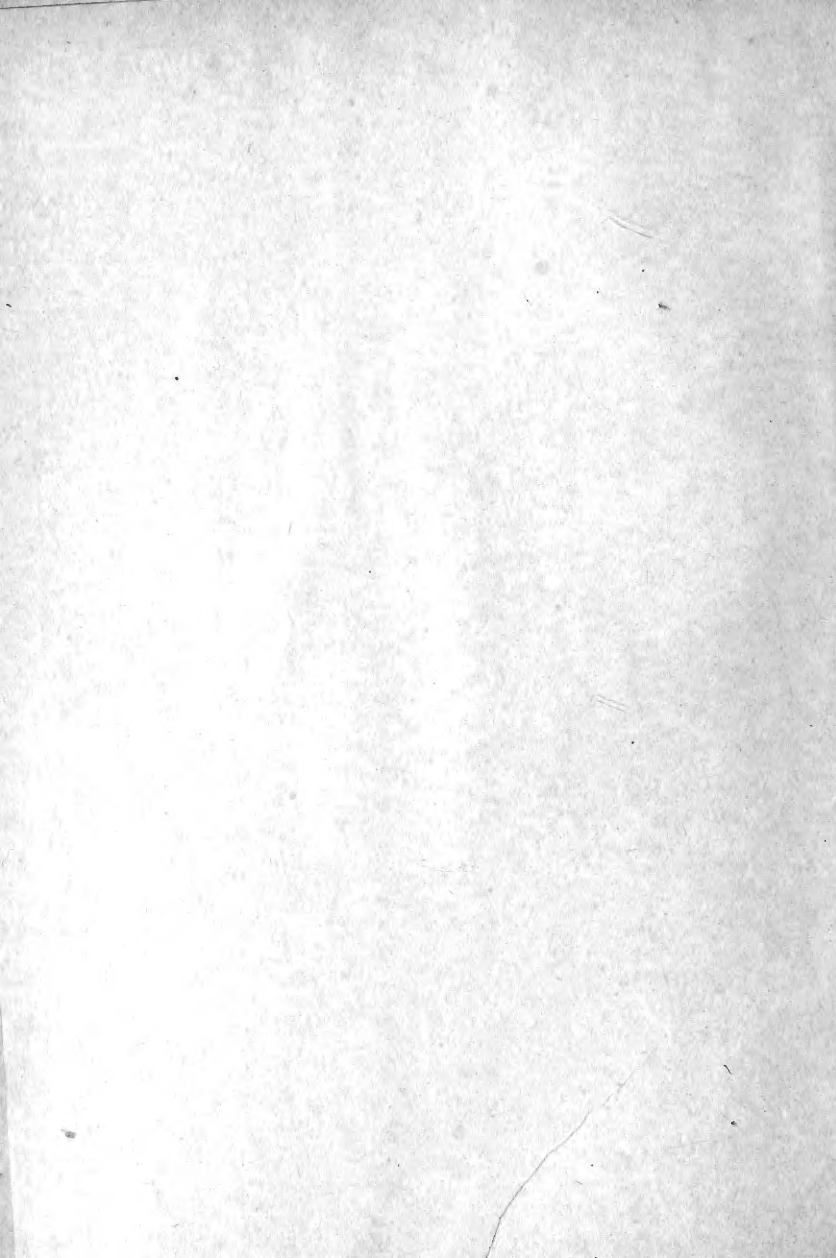
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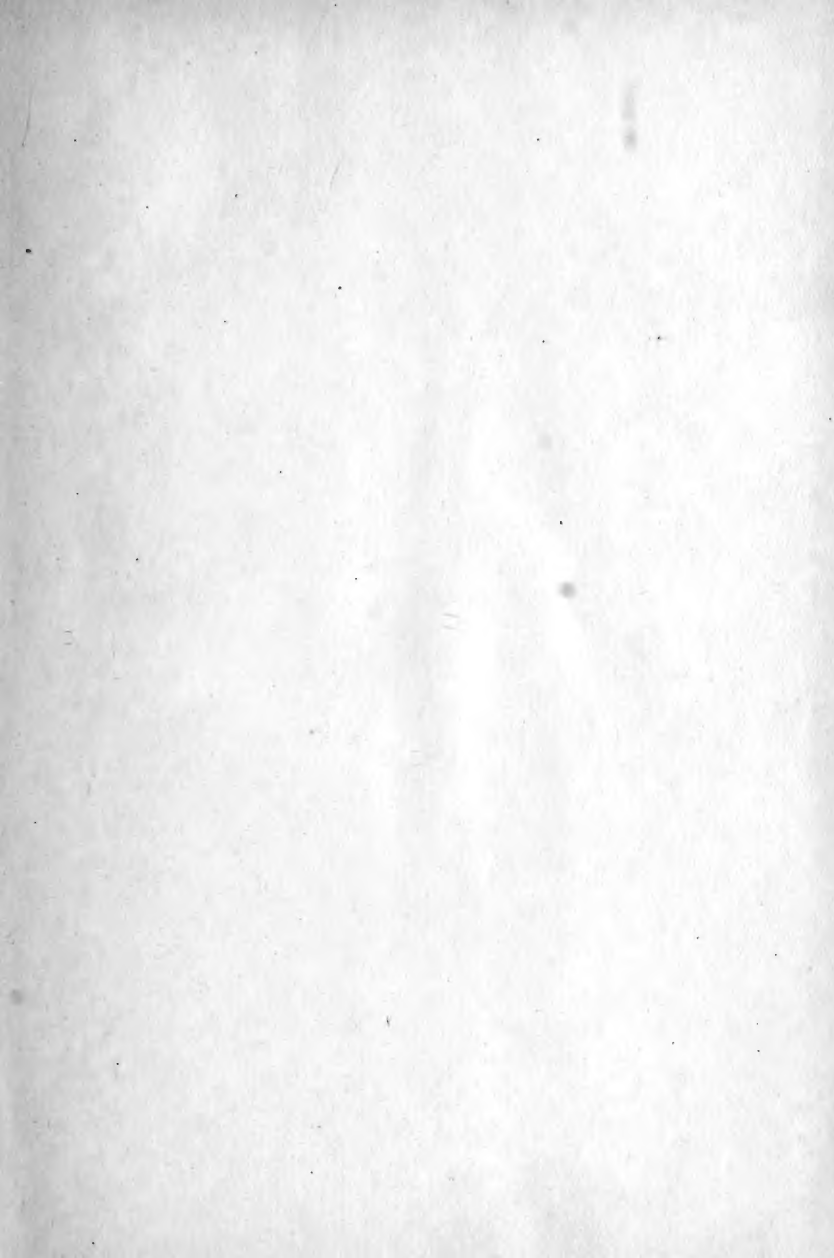
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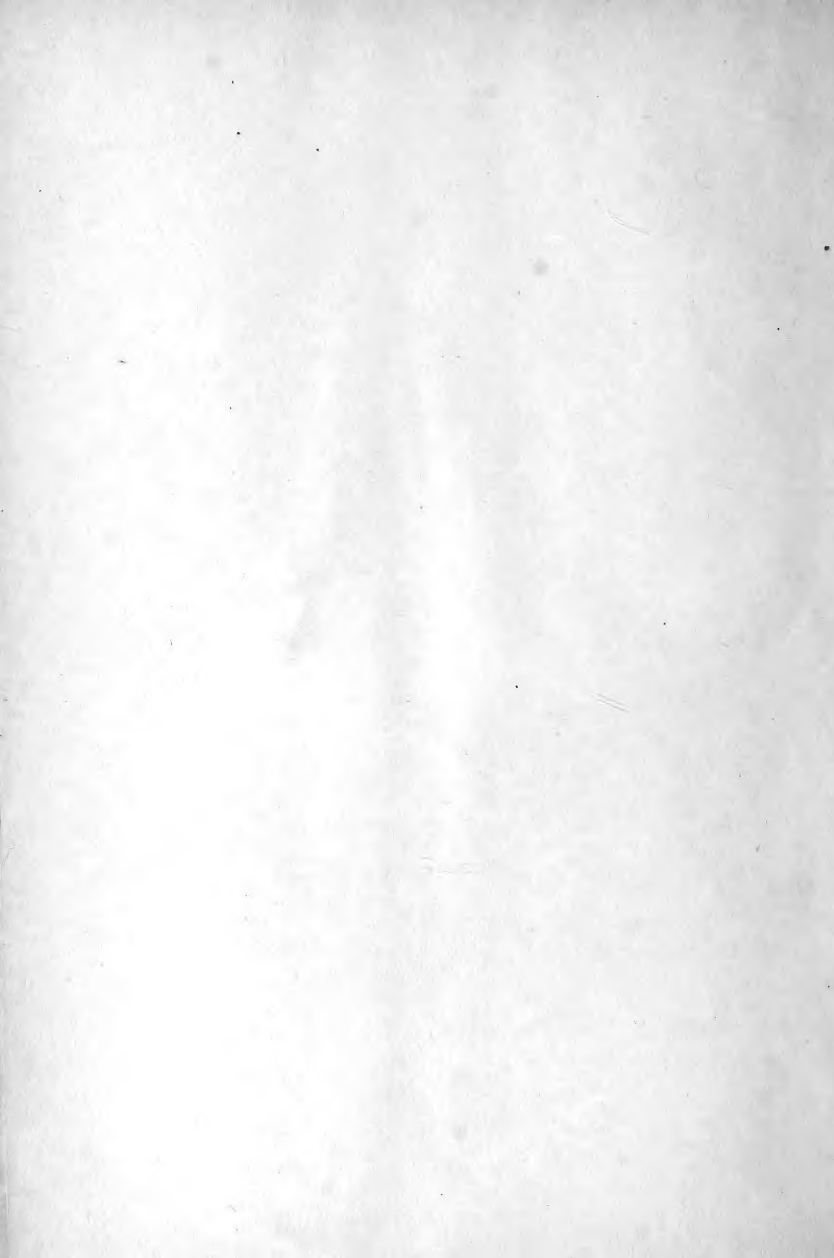
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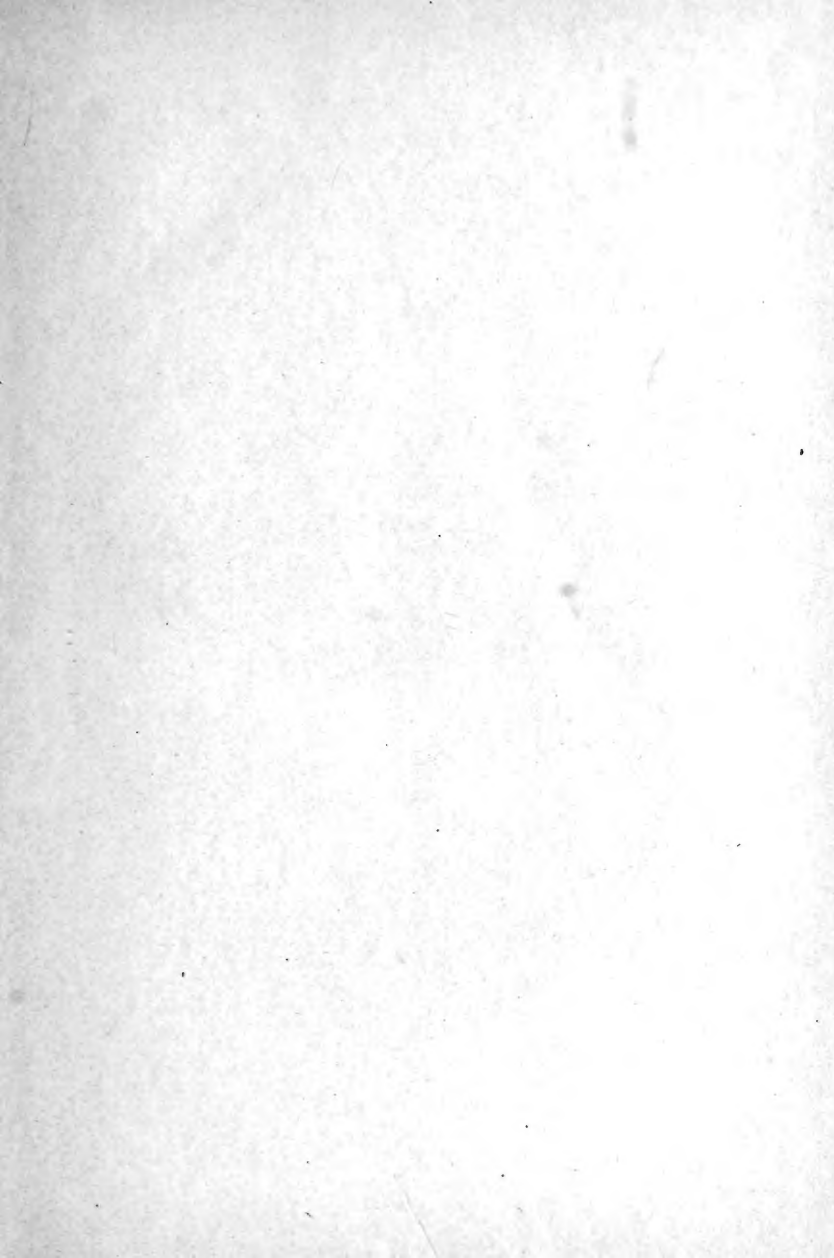
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Yours for better farming.
James B. Hunscomb

HUNNICUTT'S AGRICULTURE

FOR THE

COMMON SCHOOLS

BY

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PREFACE

The subject of Agriculture is receiving much attention at the present by educators in all parts of the world, and is being incorporated into all of our school curricula. In order to meet the increasing demands for information on the subject, teachers are being forced to give time and attention to it in order to give the instruction in a subject that is required by law in most of the States. It is important therefore that a text book on the elementary principles of Agriculture should have timely suggestions on how to teach and use material for teaching the subject as well as to contain a great mass of information. Most of us can give information on agricultural topics, but there are a very few who can successfully tell how to teach it and make a book interesting enough to attract pupils to the study. Most of them study it because they are required to do so, as many of our teachers are teaching it. This ought not so to be. It is an interesting as well as a useful study, and the author of a text should prove this beyond the questioning of the most pedantic teacher.

The first requisite for such a text it seems should be an easy familiar style, short pithy paragraphs, and conversational suggestions. The book should talk with the teacher and pupils—figuratively speaking—rather than contain long discourses on Agricultural subjects. Every chapter in such a book should make the teacher wish to

have pupils experiment with plants and the soil, or animals, and then suggest just how such experiments can be conducted in any school, with a minimum cost, but with the one purpose of developing the subject as a trade, profession or art, worthy of the best talent in the land.

Hunnicut's Agriculture for the Common Schools, written by Dr. J. B. Hunnicutt, is a pioneer in its particular field, and is well known to thousands of farmers and teachers in the Southern States. It was prepared with a view to its use by farmers and general readers as well as schools; special attention was given to an exposition rather than a presentation of the subject; more information about the problems of the farm and the farmer, and less attention to methods of presentation of the subject to the young mind. The book is a classic on account of its pure diction and plain simple Anglo-Saxon words and is worthy of a place in any library. The author had been a public speaker for many years and had developed a style that is quite pleasing.

The present edition of the book is almost entirely re-written, with a view to giving definite instruction on class-room work in Agriculture, to indicate how and where to find material with which to teach the subject, and lastly how to use this material to the best advantage. Most of the elementary books and many of the advanced treatises on the subject of Agriculture have been consulted, for which acknowledgments are here made.

R. J. H. DELOACH.

Athens, Ga., 1913.

INTRODUCTION

Plow deep and on a level,
In peace and plenty revel.

That is science as well as rhyme. Pulverize the soil and get pay for your toil. The farmer feeds and clothes the millions. To help him do this with pleasure and profit is the mission of this little book. Every farmer in the South should have this helper at hand and learn to take more pride in being a farmer.

The first thing, except one, that we remember in this world, we shouldered our hoe and marched off to the cotton field. So we were taught to plow and to hoe, to reap and to mow, and always keep up with our row. Through life we have continued to study soil and plants. We have found pleasure and profit in learning how to make the soil grow good crops.

Now, in response to a thousand requests, we have tried to tell how to do this.

But if farming ever reaches the place among other callings which it should have, it will be when we have taught our children its beauty and its rank in the schoolroom. Agriculture should be taught in every school.

We have made it so simple that any teacher can use this book, even if entirely ignorant of the principles of Agriculture or the practices of farming.

We think the student who has studied this book will see the world with different eyes.

City life has been absorbing the brain and beauty of the country. And it needs it. But we

can not afford to spare so much of our young manhood and womanhood as we have been doing. We must keep the young folks on the farm.

Many books have been written on Agriculture, but they are all more or less treatises on botany and agricultural chemistry. We have avoided this channel. While we adhere strictly to scientific truth, we have used plain language. Technical terms have been left out. We have tried to write so that every child could understand. How we have succeeded we must leave you to judge. Industrial education is the demand of the day. Agriculture is the largest and most important of the industries. Heretofore it has been at the bottom. Let us now see that it is placed at the top. To do this, we must educate the farmers.

The world will respect brain. If we make ourselves the equals in intellect of those in other callings, then we will be as much respected, and not until then.

We need as much skill to grow plants as does the physician to heal the sick, or the lawyer to clear criminals.

It takes as much brain to run a four-horse farm as to run a bank or a railroad. The farmer carries *all*.

If the farmer fails
And can not buy,
Then the merchant's goods
On his shelf must lie.

If the farmer fails
And has nothing to sell,
Then the banker's account
Ceases to swell.

If the farmer fails
And has nothing to ship,
The railway train
Makes an empty trip.

If the farmer fails—
Hasn't the money he ought,
Then the lawyer's fee
Drops down a naught.

If the farmer fails
And hasn't the bills,
Then the doctor
Ceases to roll his pills.

If the farmer fails
And can not pay,
The school teacher's account
Waits another day.

If the farmer fails,
As sometimes fail he must,
The world's business lags
And the wheels o' commerce rust

But if the farmer succeeds,
As succeed he should,
We all look happy
And we all feel good.

For upon our broad shoulders,
All the rest do lie,
And sometimes the pile
Gets very, very high.

Success to the farmer.

Atlanta, Ga., 1903.

JAMES B. HUNNICUTT.

List of Apparatus.—In order to teach Agriculture successfully teachers must have certain material with which to carry the lessons home to the students. The best apparatus for this purpose is that which can be made at home and at school, and out of the home-made material. Make whatever you can without buying anything. The following is a suggested list, and it is hoped that most of the material can be secured:

- 100 feet dressed lumber in sizes 1x3, 1x8, and 2x4. 5 pounds 6d nails.
- 25 germinating pots, 6 in. at top by 5 in. at bottom—may be made out of lumber.
- 6 flower pots of size to suit plants—may be made at school.
- 1 set garden tools, including small hand plow.
- 12 soil pans.
- 6 150mm evaporating dishes.
- 1 small drying oven.
- 4 alcohol lamps.
- 2 thermometers.
- 1 small spray outfit.
- 1 pair pruning shears.
- 12 six ounce bottles with cork stoppers.
- 3 sixteen ounce bottles with cork stoppers.
- 1 mortar and pestle, medium size.
- 1 small geologist's hammer.
- 12 packages red litmus paper.
- 12 packages blue litmus paper.
- 12 ten-inch white crockery plates.
- 12 plain straight lamp chimneys.
- 12 common glass tumblers.
- 2 one-gallon glass pitchers.
- 10 pipettes, 10cc.
- 10 cylinder measures, 25cc.
- 10 cylinder measures, 100cc.
- 10 cylinder measures, 500cc.
- 2 scales, accurate, one measuring from grains to grams, the other tenth ounces up to ten pounds.

Of course some schools will not be able to get all these utensils, but it may well be said that if the subject is to be taught successfully teachers will naturally resort to such material as found in the above list that they may the more easily impress the various lessons outlined in this little volume.

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BOB WHITE—HE HELPS THE FARMER FIGHT INSECT PESTS.

Photo Courtesy DuPont Powder Co.

Hunnicutt's Agriculture

FOR THE

Common Schools

Revised and Rewritten by R. J. H. DeLoach

AGRICULTURE MAN'S CHIEF PURSUIT.



Agriculture is the noblest pursuit of man. Before he fell, Adam dressed the Garden of Eden. Partaking of forbidden fruit was the cause of the

fall. The sentence pronounced upon fallen man was that "in the sweat of thy face shalt thou eat bread." The sentence pronounced upon the ground was that "thorns and thistles shall it bring forth to thee." The result of these two sentences remains in full force to this day.

The evil growth is spontaneous. The good must be cultivated, and from this cultivation all the race must eat their bread. This means that

we can not live without cultivating the ground. We must destroy evil and useless plants and keep good and innocent plants. The work necessary to do this is called Agriculture, which word signifies tilling or cultivating the field.

All other pursuits, callings and professions among men grow out of the necessities of the agriculturist, and are largely dependent upon him for their support. The farmer needed tools with which to cultivate his crops, hence the blacksmith came into being. He needed houses, and thus called for the carpenter's skill. The blacksmith and carpenter needed iron and steel, hence the miner was called for. The farmer needed schools for his children, that they might not grow up in ignorance, and thus called forth the teacher. His religious wants called for the preacher, and his legal rights demanded government and laws, and hence lawyers, judges and officers of all ranks came in due time to serve the farmer's necessities. Disease called for the physician, and increased trade called for traders and transportation, and all the mechanism of banking and commerce has sprung into existence primarily to serve the wants and wishes of the tiller of the soil.

Successive generations have multiplied these. Science, art and invention have contributed to the rapid development of society, and now we see a vast, complex civilization dependent upon mining, manufacture and agriculture for support.

Agriculture is easily the chief of these three, because we can not live without bread, and bread grows from the ground. "The king himself is fed

from the field." No amount of education, learning, science, invention, industry, or skill can do away with the necessity for cultivating the ground. The more these increase and flourish, the greater the need for the products of the farm. They only increase the number of non-producers to be clothed, fed and sustained by the cultivators of the soil. The farmer must feed himself and his family as well as all these others; so we see he is the most useful man of all. His calling, pursuit or profession is therefore the most useful of all professions. If this is true, it should be considered the most honorable, but for many reasons it is not so considered. These reasons we shall examine later on, when you will be prepared to understand them better. Most young people and many older people think it is more desirable to be a professional man, such as a physician, merchant, banker, lawyer, or the like, than to be a laboring man, and many prefer to labor at anything in the shade rather than in the sunshine. We have thus come to look upon farming as the least honorable of all pursuits. The chief reason for this is the fact that we have taught our educated children to go into other pursuits, and the uneducated, or less educated, to go to the farm.

Brain controls muscle. Men will respect brain. The pursuit or profession enjoying the highest education will be the most honored. In the past Agriculture has not been taught in the common schools. It is now coming to be generally taught, and this book will try to help in bringing about this change.

Agriculture as a Science.—God has made this world by law. He has so arranged everything in it, both in the moral and physical universe, that there are no accidents. All things continue to exist by definite, fixed laws.

Science is what man knows about God's laws. Chemistry is what we know about the *laws* that control the movements and existence of the ultimate minute atoms and molecules of matter. *Physics* is what we have learned of the laws that regulate larger bodies of matter. Hence we speak of the *Science of Chemistry*, the *Science of Physics*, meaning not all that God knows about these things, but what we have learned of His laws concerning them.

The earth, or soil, was created and adapted to cause seed to germinate, or sprout, and grow under certain conditions. Seeds are so made that under certain conditions they will sprout and grow in the soil. Neither of these operations takes place by accident. Both always take place according to laws. These laws are fixed, definite and certain in their action. Seeds do not produce plants until the essential conditions are complied with. When these conditions or laws of life, one and all, are fulfilled, they produce plants and seed after their kind and then die; but when these conditions are wanting or when they are violated, the seeds die before they have completed their work, or produce sickly plants, of little value. These conditions are laws which God has made, and by which plants grow. They are laws as definite as the laws of chemistry or of physics, or those of

any other science. We know many of them as clearly and certainly as we know the laws of any other science. Therefore we are justified in saying that Agriculture is a science. Not only is this true, but it is the greatest of all physical



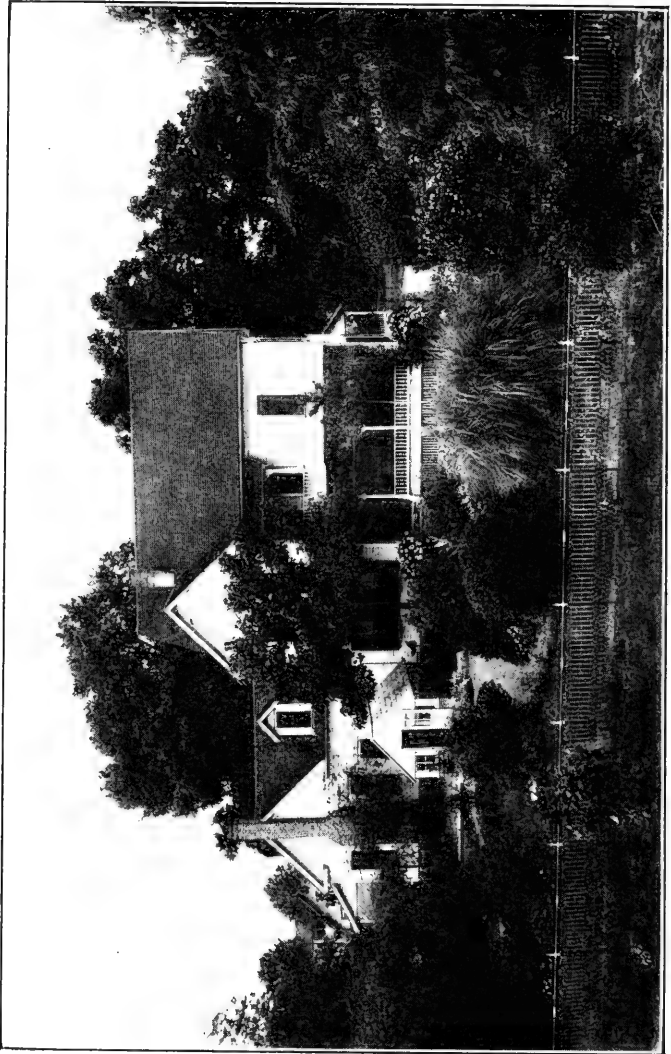
THE FARM DESOLATE AND FORLORN. THIS DRIVES THE BOY FROM THE FARM

sciences. All of the others are more or less related to and grow out of this science.

Chemistry is largely a science of the growth and uses of plants and soils and of the elements that enter into soil composition and plant life.

Physics is largely a knowledge of the laws that control the elements of plant life, growth and utilization. Heat, light, electricity, moisture, winds, gaseous movements, and such, are all contributory to healthy plant growth.

Agriculture does not stop with the study of



AN IDEAL COUNTRY HOME.
(Every one loves such a place, though he deny being sentimental.)

soils and plants, but has much to do with animal life and development. "All flesh is grass", and the growing, handling, care and utilization of animals is a very important part of every successful farmer's work. Bee-farming, poultry-farming, dairy-farming, cattle-growing, and many more instances, show that animal industries are a part of farm economy. The insects and birds contribute to our success or failure as they are harmful or helpful. Even microscopic life often enters largely into the account of success or failure. All the way from the microscopic to the telescopic worlds, we are much concerned. The heavens are scanned and the seasons foretold and "weather probabilities" forecast for our benefit.

Agriculture touches all nature when the interest of living man is considered. It is indeed the greatest of all sciences. No other science proposes to take the unorganized and organize it, to give life to the sleeping germ and growth to the silent dust. If it does not create, it brings us into closest contact with the Creator. To know the laws which govern the life, health and growth of plants and animals is to know the science of Agriculture.

The History of Agriculture.—We can not give space for anything like a complete history, nor can we get satisfactory information if we had the room. Agriculture has received very little attention from historians. We get glimpses here and there which throw some light upon its condition through all the ages past.

In the times of which Moses wrote, some enor-

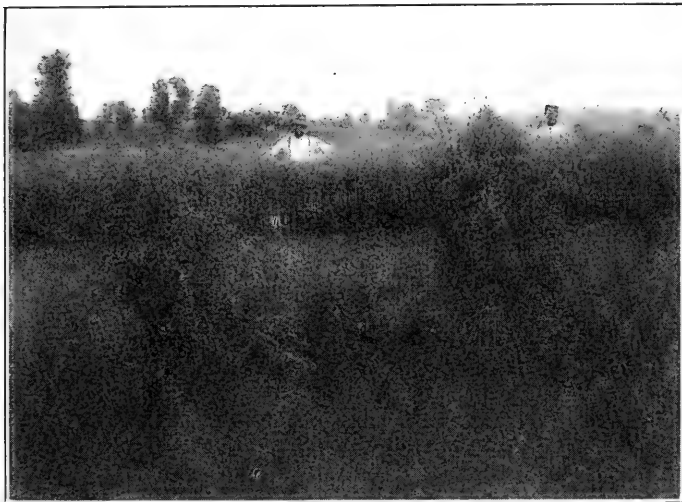
mous crops were grown in Egypt, but very little is said about the methods used. It seems to have been the exceeding richness of the soil that lay along the Nile, rather than the methods of cultivation. But we are not at liberty to conclude that the grapes of Eshcol were a wild growth. In after years the children of Israel made the land of Canaan yield such abundant crops of all kinds that we must believe that their methods of culture were not very crude. That country will not today support one-tenth of the population which then lived in great luxury on it.

The Romans gave great attention to their farms. Many of their best statesmen and orators prided themselves upon their skill in conducting their farms and the beauty of their country homes. Virgil gives a minute description of their fruit farms.

But we find the oldest nations, like the Chinese, still pursuing very crude methods of farming. They use the poorest of implements and exhibit but little skill and science in the matter. So of many other old countries, which pride themselves in the fact of their history covering many centuries.

We feel justified in saying that the people who have farmed best have been the strongest people, and have had most influence upon the world's history and growth in all that is good. But the Science of Agriculture is a new science. Little seems to have been known of soil adaption to plant production until comparatively recent years. The study of the laws of plant germination and growth

is still more recent. It has been hardly half a century since this study took definite shape and systematic form. The application of plant analysis to the products of the farm, and thereby finding the wants of plants and how they are to be supplied, has wrought a revolution in farming.



THE MAN WHO GROWS CROPS LIKE THIS PUTS THE FARM ON A PAYING BASIS.

We no longer grow plants as if it were by accident. We may now know what any plant wants for breakfast, and how it will have it served. We know many of the laws which regulate plant life.

Since we have entered upon this new era of farming, we can teach with certainty how to succeed in many lines of Agriculture.

England, Germany, France, the United States

and all civilized nations have established schools, experiment stations and colleges for the instruction of their farmers in this great and useful science.

Our government has appropriated money to maintain one such station and college in each State and Territory. Able faculties are maintained in each of these colleges to teach the young men of the country to farm scientifically.

Many books are written annually and numerous journals published to help spread this valuable knowledge among those who can not go to the schools and colleges, and the schools are now actively teaching the subject to all who enter their portals.

So we see this science, so long neglected or little known, after having slumbered for nearly six thousand years, now, at the dawn of the last century, coming right to the front and claiming to be equal in importance to any.

The chemistry side of Agriculture has already demanded and received serious attention, and books on that subject flood the market. What is needed now is a few good books, written by men of large experience in farming, on the practical side of this great subject.

The laws are known and the theories are numerous and good. We need to have the theory put into practice, so as to show its correctness and value.

CHAPTER I.

THE SOIL.

Some Ways of Showing How Soils are Formed.—

Find a large stone or rock and observe the fine sand and small pebbles that lie about it. Brush from the surface of the stone the loose pebbles and gravel. These show the first steps in the formation of soils from rock. Take small rocks into the school room and with a hammer crush them into fine pebbles. Continue this process till there is produced very fine grained sand.

Compare the crushed rock to the fine sand and pebbles newly formed from the larger rocks by natural processes. Do they look the same? What are the differences? The gravel made by hammering the rock is usually harder and less brittle than that formed by nature or *weathering*. This process called weathering is a very important process and to it may be traced the beginnings of a large part of the soil. We should look in our dictionary for the term, also in our cyclopædias, and learn all we can about it. In fact we should find a convenient sized rock and leave it by the school house, where the rains can fall on it and freeze and thaw, and then see from year to year how the fine pebbles flake off from it as the process of weathering goes on.

We are reasonably certain that when the earth first cooled down there was no soil anywhere, but

only masses of rock. After countless ages, when the earth got cool enough and began to freeze, the rocks began to flake off and form a crude kind of soil. This was not soil according to our present conception of soil, but it was the beginning of soil. It was the crude material out of which all soil has been made.

By the time plants in great numbers and animals and man appeared on the earth, the outer crust of rocks had rotted and crumbled away and formed what we now call soil and subsoil. Rain-water soaks into the surface of rocks and freezes, thereby flaking off small particles. These particles accumulate through the years into quite a mass, and this mass it is that forms the basis of our present soils over the entire face of the earth.

To quote from Bailey's *Cyclopædia of Agriculture*: "The soil is not a mere inert mixture. Its parts have shape and size and arrangement, as well as being merely composed of certain substances. All of these parts have been separately formed, moved, and assorted, and then laid down together as we find them; and, moreover, they are not even yet at rest, but are always taking new forms and new places and making new partnerships, entailing a never-ending series of mysteries. From the soil all things come; and into it all things at last return; and yet it is always new and fresh and clean, and always ready for new generations. This soft thin crust of the earth—so infinitesimally thin that it cannot be shown in proper scale on any globe or chart—supports all the countless myriads of men and animals and

plants, and has supported them for countless cycles and will continue to support them for other countless cycles. In view of all this achievement, it is not strange that we do not yet know the soil and understand it; and we are in mood to be patient with our shortcomings.”

CHAPTER II.

FORMATION OF SOILS.

Soil Formation.—In the former chapter we learned something of the source of soils and had some suggestions of how big is the problem of the study of soils. Now we are to get some idea of how nature actually manufactures soils out of the original rocks of mother earth. Of course we do not know all of nature's methods of forming soils. We can observe some of her ways and thereby get acquainted with a few of her secrets.

Collect several smooth and several angular rocks for a school-room museum. Can we not imagine that all were rough and angular at one time? What changed them into smooth stones? Generally this change is brought about by the action of moving water, moving ice, and in some places to some extent by moving atmosphere or wind laden with fine sand or dust. Moving water and ice aid mostly in reducing rock to soil.

Perhaps the most active agents now known in the formation of soils are as follows:

1. Moving water.
2. Ice.
3. Weathering, (in which process ice also plays the best part).
4. Winds.
5. Living animals.
6. Living plants.
7. Decaying animals and plants.
8. Acids and gases.

It is not necessary to discuss these agencies

here. We only need to think about them, and prepare to make further study of them when the time is ripe for it. We should, however, make some observations on a few of them.

Relation of Decaying Animals and Plants to Soils.—Whatever of organic matter there is in the soil must have come from decaying animals and plants, and as this is a very necessary ingredient, we should give special attention to this division of the subject and learn how to increase the organic matter in our soils in order to make better crops and larger yields. Another chapter will be devoted entirely to this subject.

Relation of Living Animals and Plants to Soil Formation.—Earthworms can be observed almost any time in spring and summer, depositing their worm-shaped piles of earth and thereby renewing the surface soil. They enrich the soil by increasing the nitrogen content, and perhaps change the chemical composition otherwise. Other animals to be mentioned in this connection are ants, moles, and other burrowing animals. How do these help to form soil?

Examine the roots of growing plants, especially those that grow on or about rock. It will be observed that they pierce the rocks and help to break them down and form soil. Plants also produce acids to some extent which aid in reducing rock. The living bacteria of the soil, which are so small that they cannot be seen without being magnified many times, are wonderfully active in reducing all kinds of decaying matter to soil, and making it available for use by growing plants.

CHAPTER III. SOIL ELEMENTS.

What is an Element?—An element is a substance that cannot be or has not been divided into two or more simpler substances. Gold is an element because it cannot be divided into simpler substances. Silver, iron, copper, and the like are elements for the same reason. There are as many as seventy-five of these simple elements that cannot be divided into two or more substances, and the various combinations of two or more of them into compounds make up the whole of nature as we see it.

Growing things differ from each other only in this one essential fact, that they have slightly different combinations of elements that go into their making. The soil is the storehouse for much of the material that goes to make plants, and plants differ from animals in that they can make living matter out of these simple elements in the soil. What a wonderful law it is under the operation of which several of these elements—such as carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, iron, and several others—can combine under certain conditions and make a cotton plant, and then under certain other conditions make a corn plant! This world of nature that surrounds us is filled with such wonders and we shall find it exceedingly fascinating to make little excursions into that fairy-land of science that is sometimes called Agriculture.

The essential elements of the soil, so far as they are useful to man and subserve his purposes

in the production of useful plants, are those named above: Nitrogen, phosphorus, potassium, oxygen, hydrogen, carbon, iron, calcium, and a few others of less importance. A soil in order to be considered good must have all these in sufficient quantities to afford the plant ample food supply, as all of them except carbon must come through the root system to all parts of the plant. We shall learn later how carbon is supplied to the plant.

All but three of these elements are always found in sufficient quantities in the soil and do not have to be supplied by man. The three about which man should be most concerned are nitrogen, potassium and phosphorus as they have to be supplied constantly to almost all soils. Another element that must be supplied to most soils from time to time is calcium which is usually applied in the form of *lime*. Much more will be said about these elements and how best to secure and apply them, in connection with fertilizers and manures.

We thus see that the soil is not a very simple thing to be easily understood without much study. It is a mixture of many compounds of many elementary substances, and through many years of adjustment has become exactly suited to the growth of plants. Perhaps the plants too have done their part in adjusting themselves to the soil in which they grow. This mutual relationship between the soil and the organic life that grows in it is one of the best illustrations that can be cited of the wonderful power of adaptation in nature.

CHAPTER IV.

KINDS OF SOIL.

General Classification.—Soils are classified into the following groups: sandy soils, clayey soils, loamy soils, swamp soils, limestone soils, alkali soils and arid soils; each class being determined by the amount of sand, clay and humus or other ingredients contained therein. These various classes differ in their composition, those containing a large per cent of sand being determined sandy soils, and those containing a large per cent of clay being called clayey soils. Sand soils contain about seventy per cent of sand and clay soils have about the same per cent of clay. Soils which have about one-half clay and one-half sand are called loamy soils. When they have more sand than clay, about sixty per cent sand and forty per cent clay, they are called sandy loams. If they have more clay, about sixty per cent, and less sand, about forty per cent, they are called clay loams. We find, then, sandy, clayey and loamy soils, all varying with the relative quantities of sand and clay entering into their composition. This classification is based entirely upon the mechanical structure of the soil. Sand is the name given to coarse particles and clay the name given to fine particles.

How to Find the Amount of Sand Contained in Soil.—Put in a glass jar about a pint of ordinary soil and fill the jar almost full with water. Shake this well and let stand; the sand will settle at the

bottom, and the clay next, the coarser particles of clay settling above the finer. This form of experiment should be made on a number of kinds of soil and in this way determine according to the above to what class each soil thus treated belongs. The muddy look of the water is caused by the amount of fine particles of clay held in suspense. If this water were moving, the particles thus held in suspense would go into the rivers and some of it on down into the sea. On top of the water will be found some humus that would also get away and thereby deplete our soils.

By measuring we can calculate about what proportion of clay and sand are contained in the different samples of soil, and in this way tell to what class our several soils belong.

Sandy Soils.—Sandy soils are always easy to work, but are rather poor in plant foods. They do not hold water like the clayey soils, but absorb water rapidly and as rapidly lose it. Sandy soils are best suited to rapidly growing crops. A considerable amount of vegetable matter and commercial fertilizer incorporated into sandy soils makes them yield large crops.

Clayey Soils.—These may be easily recognized by their sticky character. Some claim that 50% of clay in a soil makes it a clay soil, while others claim that 70% of clay is required to make a soil clayey. Clayey soils are usually cold soils and suffer from extremes of rainy and dry seasons. The grasses and cereals do better on them than other crops.

Loamy Soils.—This term is applied to soils

with a mixture of sand and clay, and may be divided into sandy loams, containing a low per cent of clay; common loams, containing a slightly higher per cent of clay; clay loams, containing perhaps as much as 40% of clay; limy loams, containing some lime and a low per cent of clay. Loamy soils are fine for almost any kind of farming and are found chiefly in black prairie belts and river valleys.



CELERY IS PROFITABLE ON BOTTOM LANDS.

Other classes of soils are the lime soils, swamp soils, alkali soils, and arid and semi-arid soils, and some put another in the list under the name of humid soils where there is a heavy rainfall, or constant overflow of a river. The names applied to these last types of soil suggest what they are, but every school should make an

effort to get samples of every class of soil here given and keep for class study. This may be done through the aid of Agricultural Colleges and Experiment Stations, provided they cannot be secured locally.

Secure locally as many kinds of soil as possible, and measure a pint of each and weigh and record result. Dry out the samples thoroughly in a heating oven or by a fire, and weigh again in order to find the water holding capacity of each. In the next chapter we are to make a study of the water holding capacity of soils, and the best methods of investigating the problem.

CHAPTER V.

WATER HOLDING CAPACITY OF SOILS.

Moisture in Samples of Field Soils.—One of the greatest problems in soil physics is a study of the relation of moisture to the texture and treatment of the soil. What the soil contains, and how we cultivate it determine more than anything else what this relation shall be, whether or not it is to be a wholesome relation as regards plant growth.

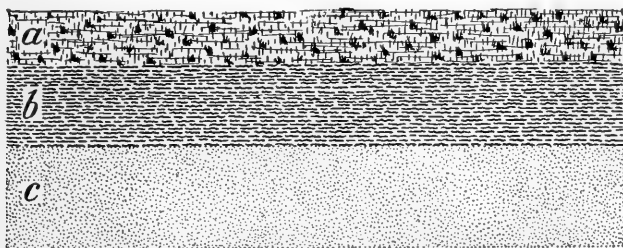
The securing of a soil with large capacity for absorbing and holding water, yet one permitting the normal growth and development of the roots of plants,—or perhaps a soil that can as well draw the water from below for the use of plants during dry weather—are conditions for which the farmer should strive, and without which he cannot get good results.

In order to get the truth about the amount of moisture contained in our soils suppose we make the following test:

Collect samples of soils from a well cultivated and fertilized field, from sandy loam, and from clayey soil. To collect these samples, secure a two-inch auger with long handle, clear away top loose soil to the depth of about a half inch, and for the surface soil or soil proper, bore down to a depth of about 7, 8, or 9 inches, the depth depending on the usual depth to which the land is plowed. Discard two inches and go to a depth of 16 inches

to get a sample of subsurface soil. Discard another two inches and for a sample of subsoil go to a depth of about 35 or 40 inches.

Take these samples all in duplicate from each of the three kinds of soils, also from the three layers of soil, making in all a total number of eighteen samples, and put each in a drying pan, taking care that no water evaporates before the samples are accurately weighed.



a—SOIL.
b—HARDPAN.
c—POROUS EARTH BELOW.

After they are accurately weighed and records made, place them in a drying oven and heat up to about 212 to 225 degrees F., or a little above the heat required for boiling water. Let the samples remain heated for about 4 or 5 hours, and then remove from the oven and weigh again. The difference between these latter weights and the former will represent the per cent of moisture held in the soils, and will represent the water holding capacity.

A number of students should be working at once in this experiment in order to keep it going properly, and should be carefully directed and

tutored in the methods of the work before beginning it. If successfully carried out, it will mean a great deal to them in the way of bringing to their attention the advantage a good soil has over a poor, and will also suggest to them how necessary it is to strive to make poor soils good.

For convenience suppose small outlines for tables be drawn after the following manner:

Sample No.	Wt. of pan	Wt. of wet soil	Wt. of dry soil	Difference	% water
.....					
.....					
.....					
.....					
.....					
.....					
.....					

Conditions of the Test.—The samples of soil should be handled rapidly after taking them from the ground till they are in the oven or at least in an air tight vessel in order for them to keep the moisture in them till weighed. They should also be weighed as quickly as possible after they are taken out of the oven in order to keep them from absorbing moisture before they are weighed again. Questions that should be stressed are as follows: What kind of weather was it the week before the samples were taken? Were the samples very

moist? Which one contained the most water? Which layer contained the most moisture, the top soil, subsurface soil, or subsoil?

Attention should be directed to the reason why the good soil contained the most moisture, namely, that the vegetable matter in it both held water and kept the water in the subsoil from getting away. It must become evident that a soil that is covered with any kind of decaying vegetable matter will hold water better than mere grains of sand or clay or the mixture of the two.

CHAPTER VI.

HOW SOILS ARE MADE TO HOLD WATER LONGEST.

A Test to be Made on Soils Taken as in Last Chapter.—Secure samples of soils as in last chapter, and weigh immediately before any moisture has had time to escape. Record these weights, and then spread in a dry place and weigh the same samples every twenty-four hours, and see the difference in the rate of drying of the various samples.

Capillary Moisture.—This is the thin film of moisture around the soil particles and benefits directly the plants, and therefore is of the greatest interest to the farmer. It is the moisture that moves freely through the soil on the principle that water is soaked up in a cloth that is put in the edge of a basin containing water. Soon the cloth will be moist far above the water line. This is done by capillary attraction. So is moisture capillary moisture when it moves freely in the soil through capillary attraction.

Not all of the water film over the soil particles moves, and hence it is not all capillary water. That which does not move is called *hygroscopic* water, and does growing plants little or no good. This moisture can be driven from the particles only by a high heat, while the capillary moisture will soon evaporate if the soil is exposed to the air. Since it is the capillary moisture that is so important in agriculture, we should make every effort to prepare our soils to hold capillary moisture.

How are we to know if our soils are able to hold capillary moisture? The following test will enable

us to tell: Secure samples of soil as in the former chapter, and weigh as quickly as possible before evaporation takes place, and record the weights thus obtained. Spread out the samples in the soil pans and carefully weigh every 24 hours, until the weights become a constant,—that is do not any longer change from day to day. It will be observed that the difference between this loss of capillary moisture and the total moisture content determined in last lesson is the hygroscopic moisture. This latter is not very important; but the capillary moisture which may be obtained by calculating what per cent of loss was incurred by exposing the samples to dry air until the weights have become a constant, is of the greatest importance. Compare the capillary moisture of the various samples, and see how the good soil ranks in this particular. A number of experiments along this line will be of the greatest benefit in classwork, and should cover the greatest possible variety of soils from the poorest to the best.

It will be noticed that any kind of decaying vegetable matter will help to increase the amount of capillary moisture in any soil, and therefore should be used with this truth in mind. Any form of vegetable matter plowed under, even in the form of common hay or grass, helps wonderfully to increase the water holding capacity of the soil, an item that cannot be overlooked in the development of soil. Frequently the size of the crop that is taken from a field is determined by the water holding capacity of the soil and by this alone.

CHAPTER VII.

THE PROBLEM OF SOIL TEMPERATURE.

The Relation Between Heat and Moisture in the Soil.—It has been found that no chemical change can take place without the presence of both heat and moisture. The presence of air or oxygen is also necessary in most organic changes. Each of these three we must have, but not in such quantity as to preclude the presence of the others.

It goes without saying that a wet clammy soil is colder than a loosely constructed soil, and will retard the germination of seed in spring, and the growth of plants in any season. The color of a soil has much to do with its temperature, but the question of drainage plays the bigger part. Some soils are easily drained while others are not. A sandy soil is generally an easily drained soil while a clay soil is not easily drained. To show how important drainage is to successful farming, suppose we make the following test:

Make two small wooden boxes, about 2 feet square and 6 inches deep. Put good soil of the same kind in each, and have one water tight while the other has holes in its bottom. Saturate both with water, and then on a clear sunshiny day, begin in the early morning about 8 o'clock and take at frequent intervals the temperature of the soil in each box. See which one remains cooler, and explain to your satisfaction why this is.

Application of This Lesson.—Some fields have no drainage and hence present a cold chilly soil in spring for the young seeds. It takes so much heat to germinate seed, and a certain temperature for plants to grow off well, and if this condition is not satisfied we cannot get the desired results. The warmer soil is usually one that has drainage and can get more of the heat of the sun in early spring.

Some Suggestions for Securing Better Drainage.—It is not always possible to get good drainage without tile-draining, but in most cases the necessary drainage may be secured in other ways. We all have noticed that where deep plowing is done, we have better crops even with lighter applications of fertilizers. If plowing ten or eleven inches with a turn or a disc plow does not give the desired effect, we should plow our land once in three or four years with a sub-soil plow and go about fifteen or eighteen inches so the surface water will have ample room to settle below the root area of the plants before it seeps away.

We have already learned by experiment that a soil with decaying vegetable matter in it contains more capillary moisture than one without this material. It is equally true that a soil that has vegetable matter in it is much more easily drained than one without the vegetable matter, and this is an additional reason why we should strive in every way possible to increase the vegetable matter in our soils.

Tile-draining.—We are not going to consider tile-draining in this connection, but it seems

timely to suggest in this connection that this is one of the ways of getting proper drainage in our soils. Most of our rich bottom lands could be made to double their yield without increasing the fertilizers, if they were properly tile-drained; and it is as certain that many of our hill-sides need only to be tile-drained in order to put new life in them. In another chapter we are going to have more to say on this subject.

Relation of Color to Temperature in Soils.—

A dark colored soil is warmer than a light colored soil, as may be proven by the following simple test: Make a flat box about three feet by six feet, and six inches in depth, with bottom not too tight so that water can easily run through it. Fill one end with the lightest colored soil you can find and the other with some very dark soil. Keep the partitions well marked by a board or some other marking. Keep moderately moist. In one side put several kinds of farm-crop seed and put the same kinds of seed on the other side and in relatively the same position. Keep notes on which side the seed germinate first. Keep the temperature of the soil on each side carefully in your notes, and see if you cannot associate this with the difference in the time of the germination of the seed on the different sides. This is one of the most interesting as well as essential experiments that can be made, and is very simple too.

CHAPTER VIII.

EFFECT OF LIME ON SOILS.

Friable Soil.—Friable soil is any soil that easily crumbles or pulverizes, and is easily worked. This condition is sometimes hard to secure, in heavy red uplands, and farmers have to apply lime to the soil in order to get the proper results. When clay soils are plowed too wet, they form large heavy clumps that can hardly be worked out in a whole season. Many clay soils that have been improperly worked run together and after a rain will crust over almost like brick or cement.

In order for soils to be in good condition for tilth, they must form medium to small size crumbs, perhaps about the size of alfalfa seed, and these must lie loosely together. This is just what lime does for heavy soils; it causes the particles to flocculate, and form a kind of crumbly texture. This, of course, makes the soil lighter to till and causes better drainage.

In a small area in the plots about the school ground, clear off a small piece of ground, say a small area of about 8x16 feet, and on one-fourth, put no lime; on the second fourth, put one quart of lime; on the third fourth, two quarts; on the fourth, three quarts. Plant some convenient crop and notice just how different the several plots will respond to cultivation. Calculate how much per acre of lime you applied at the above rates.

Other Benefits of Lime Applied to the Soil.—

Some soils are acid, or have too high per cent of carbonic acid in them. This condition usually obtains in low places, or mucky swamp lands. To correct this evil, a good deal of lime must be applied, once every few years. The acid is produced by the decay of vegetable matter, and generally indicates a rich soil otherwise.

There are certain small organisms in the soil that do much better in their work of reducing decaying vegetable matter to plant food material, under the influence of lime or some other form of carbonate than when these materials are not applied. The organisms seem to get the carbon in their little bodies or shells from practically no other source. The organisms themselves are very essential to the health of the soil, and hence their health should be as carefully looked after as the health of the plant.

Some farmers think that lime is a fertilizer, but it is not in the sense that other materials are fertilizers. It very often releases the forces of nature and aids plants materially in making use of other forms of fertilizer, but it is no fertilizer in itself. He who applies it should have in mind the real function of lime to the soil, to the plant, and to the soil organisms, if he would plan wisely its application.

How Much Lime to Apply.—This depends on what we apply it for, as well as on the condition of our land. To aid in stimulating the soil organisms we apply only about 500 pounds to the acre. To correct the acidity of an acid soil we should

apply from 1,000 to 3,000 pounds per acre, depending on the amount or per cent of acid in the soil. If we use lime to make our heavy lands friable, we need apply as much as we can conveniently apply up to two tons, the minimum depending on the closeness of the soil as well as its hardness.

What Kind of Lime to Apply.—It might be well to consider this topic one of the greatest importance, as farmers who apply quick lime to the soil injure the soil bacteria. Quick lime and slaked lime both help to set free plant food, especially nitrogen, but inasmuch as the slaked lime does the good without doing any injury, it is the proper form to use. Its effect upon the granulation of clay soils is slightly less than the quick lime, but the freedom from all harm makes it the safer to use.

CHAPTER IX.

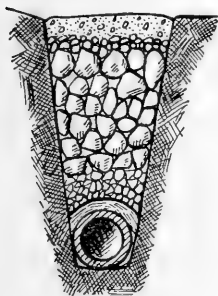
SOIL DRAINAGE.

The Importance of Soil Drainage.—All farm crops must have a well ventilated soil in which to grow. If the water stands too near the surface, the plants will soon sicken and die. The hydrostatic water must be below the normal depth of the root system of the plants if we expect perfect development. Thousands of acres of lowlands and swamp lands have been reclaimed by drainage, and millions of acres of uplands can be made to double the present yield by careful drainage.

What is Soil Drainage?—Soil drainage is the draining of water from soils that ordinarily are not properly drained naturally. Such soils are either from their nature too sticky, or shallow, or are lowlands, and to drain them means to make possible the proper aeration of that portion in which plants grow, that was not ventilated before. A soil in which water stands to within a few inches of the surface too long during a rainy season, is not suited to the development of plant life, and has to be ventilated if used to the best advantage.

Methods of Drainage.—The common practice is to ditch or tile-drain, either of which may be done with very little difficulty. Lowlands may be ditched in sections and tile-drained between ditches. In fact this is quite necessary to get the best results. On hill-sides, only the underground drains are possible. Farmers often have a barren

hill-side that never makes a profitable crop and are at a loss to know just what is the trouble. In most cases, a tile-drain on the brow of the hill will remove all difficulty. The water that falls on top of the hill or upland seeps out at the edge of the hill and keeps the hydrostatic water too near the surface, and plants will not grow. This condition may not last longer than the rainy seasons in spring and early summer, and autumn, but this will be quite sufficient to hinder the growth of plants, and hence keep the spots barren. A tile-drain run just on the turn of the hill, will catch most of the water, and help to air the soil,



A DRAIN DITCH.

and crops will begin to flourish there immediately.

Effects of Drainage.—We were required to construct two boxes for conducting an experiment outlined in Chapter VII. If we take these two boxes and fill them each with the same kind of soil, plant seed in them, and saturate with water, we shall see which one germinates the seed earlier, the box that has the drainage or the one that is water tight. The well drained box not only has the moisture problem of the soil regulated, but also regulates the heat, by having the water properly reduced. We may say then that to regulate the water content of the soil by proper drainage is to regulate the temperature as well, and make ideal or natural conditions for plant growth.

The Cost of Drainage.—This will always depend on several conditions:

On the kind of labor employed in ditching,

The nature of the soil,

The depth of the ditch,

The distance apart that the tiling is to be put,

Price and freight—or total cost of tile.

All these things considered, the cost will range between \$25.00 and \$40.00 per acre, counting on getting labor at a normal price and having to ditch land that is medium—not too hard nor too soft. A few good farmers with well organized labor have reduced the cost to about \$21.50 per acre, but this is the exception and not the rule.

Ralph Waldo Emerson, the poet and philosopher says: “Tiles are political economists. They are so many young Americans, announcing a better era and a day of fat things.” It is claimed by many that the land that needs tile-drainage will pay for all expenses for tiling the first year, in the increase of production. This sounds like a rather extravagant claim for the merits of tiling, but the most enthusiastic advocates of tile-drainage are those who have tried it. Invariably they have been greatly profited.

Ditches for tile-draining need not be more than 18 to 20 inches deep, and should be about 20 to 40 feet apart depending on the stiffness of the soil that is to be drained. Tile should be put in a straight bottom ditch, not bobbing up and down, and should have enough fall to insure drainage,

and lead to an open ditch or a main pipe at the junction of two gently sloping hill-sides. In other words, the main pipes should usually follow a drain made by surface water, or a gully, and should also have enough fall to insure draining.

CHAPTER X. IRRIGATION.

Importance of Irrigation.—A great many people think that irrigation is a subject that should be studied only by those who are to make a living by farming in a dry country where the rainfall is not sufficient to keep plants alive without artificial irrigation. This is not true, as almost any farm can be made to treble the present yield if it could be properly irrigated. Out of every hundred pounds of vegetable crops produced about ninety-five pounds is water; besides this much more water evaporates through the leaves.

In order to prove the value of irrigation to our common Eastern or Southern farms, suppose we try the following simple experiment: Take two plats of ground about the school or home, not more than 6 feet square, each, and fertilize and prepare as perfectly as possible. Plant four or five hills of cotton in each, and cultivate regularly alike and keep all grass and weeds down. Let nature water one and keep the other in a proper moist condition between rainy seasons in early summer. Note in which one the plants grow faster. Why is this? To leave this little demonstration to the imagination and not carry it out as outlined, is to deprive the class of much pleasure and leave them still unconvinced of the effect of irrigation.

Sources of Water.—Only in hilly countries or hilly sections of any country could one depend on the fall of river beds for irrigation water. It is

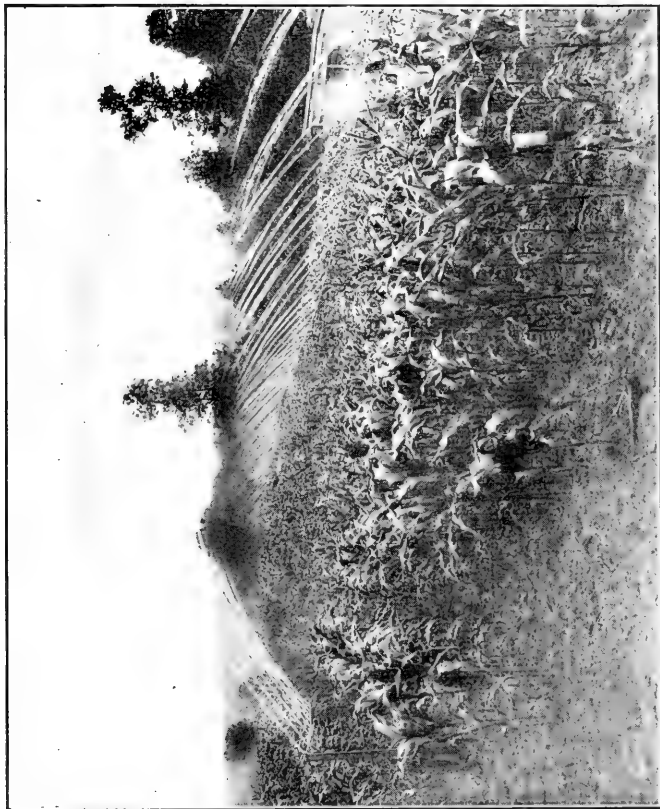
not uncommon to find that lakes and wells supply many sections with water, a small pump and gasoline engine being used to get water in the necessary quantities from either of these sources; but in any small ten acre field, many a crop would more than pay for these in one year with the proper use of the water. We have not begun to apply irrigation as it should be in the South.

Methods of Irrigation.—There are three ways of irrigating:



SURFACE IRRIGATION IN A CABBAGE FIELD.

First, we take running streams, and by using dams and ditches turn them from their natural bed or channel and carry them by gravity over the fields to be watered. To do this successfully, often requires very large outlays of money and



OVERHEAD IRRIGATION IN CORN SEVEN WEEKS FROM PLANTING.

skillful engineering. Canals have to be made hundreds of miles long and large enough to carry large rivers. Smaller and still smaller ditches are carried from these until finally the water is turned in small streams upon the fields. This method is largely employed in growing the fine fruits and grapes in California, and can be made use of wherever the country is broken and the streams have a good fall. Even where we have rain this adds very much to the yield.

A second method is to use windmills and steam-pumps and raise the water from wells, lakes or rivers, and then distribute it much as above described, the chief difference being in the method of obtaining the water. This method is generally used where there are no streams with sufficient fall, or on the plains where there are no streams at all. The water thus obtained is frequently measured out to the customers at a certain price. By these tolls the expenses of the system are paid. Private waterworks may be often utilized to greatly increase the yield of vegetables in our domestic gardens.

The third method of irrigation, if we may be pardoned for a somewhat new use of this term, is to irrigate from below, instead of from above. By this we mean that we may plow the soil so deep and pulverize it so fine that capillary attraction will bring up the water when it is needed, provided we have taken care of the fall of water in winter, when we did not need it. The heat of the summer sun and the pumping power of the plant root will greatly assist in bringing up the water.

If the land has been properly plowed, the plant roots will grow very deep in the soil—from three to seven feet, and as each of these is a skillfully made pump, all of them, acting at once, will be able to bring up great quantities of earth water. A great advantage in this method of irrigation is that, besides helping to secure all the water needed, it will help in very many other things. It will prevent all washing and leaching, and will make the soil deeper and richer from year to year. All the time it will be yielding larger and larger crops. Keep in connection with the earth water below, and this water will, by percolating through the pores of the soil, supply the growing plant with the life-giving water in hot summer. Short drouths will not injure the crops. Thus, when the poorly farmed land yields short crops, this properly worked land will give large crops when the prices are best. The farmer who properly manages the water on his land will be almost sure to be a prosperous man.

We shall readily see that it does not pay to put much water on land that is poorly cared for, as the water may take off some of the small amount of fertilizers, but with any soil that is properly cultivated and fertilized a properly regulated supply of water will always improve and make larger and better crops.

CHAPTER XI.

THE BEAUTY OF THE SOIL.

How Beauty Affects Our Education.—Certainly it is as much the duty of our teachers to place before us the poetry and beauty of the soil as it is to give the scientific and practical operations of farm life. It has been our custom to dissociate agriculture from all that is beautiful in nature, and to put it on the basis of routine and monotony. A few lessons on the *sentiment* of the soil, will win many more students to a love of farm life, and at the same time will help to put the study on its proper basis. Education is not complete unless it idealizes in a measure all that it touches upon, and certainly there is no more beautiful background for poetry, eloquence, and religion than some reflections on the genuine beauty of the soil.

The Soil in Literature.—However near heaven our poets and philosophers soar in their effort to get away from mother earth, they must sooner or later come back for food, for thought, for renewed energy and inspiration, that they may soar higher each time in the good they do. In fact, when they remain in upper air for a season, they learn without being told that mother earth is as much heaven as there is in upper space or elsewhere in the great universe, and are contented to anchor themselves anew on this blessed gift of the Great Spirit of the universe.

We therefore find literature full of references

to the soil and many of the parables in the Bible are based directly on a study of the soil. Give two soil parables, outlining the agricultural importance of same. For a month after this chapter had been studied, note in all forms of reading how often the earth and her powers and bounties are referred to. Note also what a change is coming in the references to soil in literature.

The following quotations should be read and re-read till we all get their full meaning, and then should we learn to think of them in connection with our own home farms. They are all from the best of literature, and are worthy of more study than any mere mechanical lessons in agriculture:

“As I drew a still fresher soil about the rows with my hoe, I disturbed the ashes of unchronicled nations who in primeval years lived under these heavens, and their small implements of war and hunting were brought to the light of this modern day. They lay mingled with other natural stones, some of which bore the marks of having been burned by Indian fires, and some by the sun, and also bits of pottery and glass brought hither by the recent cultivators of the soil. When my hoe tinkled against the stones, that music echoed to the woods and the sky, and was an accompaniment to my labor which yielded an instant and immeasurable crop. It was no longer beans that I hoed, nor I that hoed beans.”—Taken from Thoreau’s *Walden Pond*.

“The general evolution of this soil is toward greater powers; and yet, so nicely balanced are these powers that within his lifetime a man may ruin any part of it that society allows him to hold; and in despair he throws it back to nature to reinvigorate and to heal. We are accustomed to think of the power of man in gaining dominion over the forces of nature, he bends to his use the expansive powers of steam, the energy of electric currents, and he ranges through space in the light that he concentrates in his telescope; but while he is doing all this he sets at naught the powers in the soil beneath his feet, wastes them, and deprives himself of vast sources of energy. Man will never gain dominion until he learns from nature how to maintain the augmenting powers of the disintegrating crust of the earth.
* * * The surface of the earth is ours to do with it much as we will. It is the one great resource over which we have dominion. Within this crust are great stores of minerals and metals and of other materials that we can use for our comfort; these materials we can save and we may use

them with economy, but we can not cause them to increase. But the soil may be made better as well as worse, more as well as less; and to save the producing powers of it is far and away the most important consideration in the conservation of natural resources.

"I am glad of every new effort that puts men rationally on their feet on the soil. It will be a great thing when the soil is known in the schools. I wait for good politics and good institutions to grow out of the soil. I wait for the time, also, when we shall have good poetry and good artistic literature developing from subjects associated with the soil; for we want good literature to appeal to all men."—L. H. BAILEY.

"A little consideration of the relations of the higher animals to plants makes it clear that all the advance of the earth's life above its simpler forms depends upon the existence of moderately fertile soils such as produce food fit for the nurture of the higher forms. They could not have developed if the world had afforded no better provision for them than the license of the rocks or the mosses of the peat swamps. We thus see that the soil is really the immediate source not only of the superior kind of plants which feed in the soil, but also of the animals which depend upon them. If the plants such as those which produce fruits, grains, or nutritious herbage, had not had this field for their development, there would have been no chance for the evolution of the series of animals which has led life up to the estate of man to find a place upon the earth.

"The foregoing considerations should give the student a larger conception of the historic features of the soil coating than can be acquired by any mere limited view of their conditions. He should clearly see that this mass of debris, which at first sight seems a mere rude mingling of unrelated materials, is in truth a well organized part of nature, which has beautifully varied and adjusted its functions with the forces which operate upon it."—N. S. SHALER.

"I never tire of contemplating the soil itself, the mantle rock, as the geologists call it. It clothes the framework of the earth as the flesh clothes the bones. It is the seat of the vitality of the globe, the youngest part, the growing, changing part. Out of it we came, and to it we return. It is literally our mother as the sun is our father.

"The soil! the residuum of the rocks, the ashes of the mountains. We know what a vast stretch of time has gone to the making of it; that it has been baked and boiled, and frozen and thawed, acted upon by sun and star and wind and rain; mixed and remixed and kneaded and added to, as the house-wife kneads and moulds her bread; that it has lain under the seas in the stratified rocks for incalculable ages; that chemical and mechanical and vital forces have all had a hand in its preparation; that the vast cycles of animal and vegetable life of the foreworld have contributed to its fertility; that the life of the sea, and the monsters of the earth, and the dragons of the air, have left their ashes here, so that when I stir it with my hoe, or turn it with my spade, I know I am stirring or turning the meal of a veritable grist of the gods. * * * A handful of the soil by your door is probably the most composite thing you can find in a day's journey.

It may be an epitome of a whole geological formation, or of two or more of them. * * * Our lawns are made up of ashes from the funeral pyre of mountains, of dust from the tombs of geological ages."—JOHN BURROUGHS, *Time and Change*.

Much time should be devoted to a study of the meaning of these passages. They are good literature, and are the best authority on the formation of the earth's crust. Whether we are young or old, we shall certainly find a great treat in these beautiful tributes to the soil under our feet.

CHAPTER XII.

POSSESSION OF THE SOIL.

Let every pupil in school gather a handful of soil from some clean place about the grounds, and bring it in and place it on a piece of paper on the desk. This will be material with which to spend one study period. First try to imagine just how this soil has been formed from the rocks of the fore-world. Use a few sketches from the former chapter by way of suggestion. Imagine how vital this bit of filthy looking material must be to feed a hungry world of animals and plants!

Read the following to show the transformation that comes about in the growth of animals and plants:

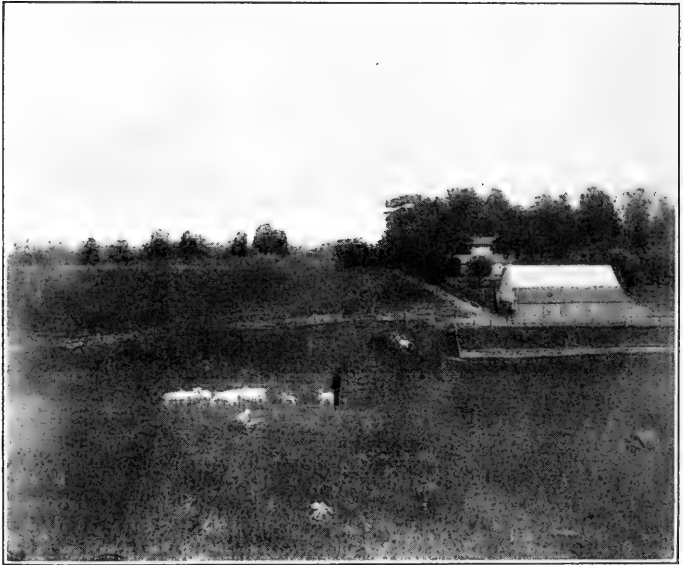
“Now I am terrified at the Earth! it is that calm and patient,
It grows such sweet things out of such corruptions,
It turns harmless and stainless on its axis, with such endless successions
of diseased corpses,
It distils such exquisite winds out of such infused fetor,
It renews with such unwitting looks, its prodigal, annual, sumptuous crops,
It gives such divine materials to men, and accepts such leavings from them
at last.”—WHITMAN, *Leaves of Grass*.

We sometimes grow vain enough to think that we really own a part of this old earth when we have a title to a piece of land. Perhaps the following from Emerson will teach us who can really own part of the earth:

“The charming landscape which I saw this morning is indubitably made up of some twenty or thirty farms. Miller owns this field, Locke

that, and Manning the woodland beyond. But none of them owns the landscape. There is a property in the horizon which no man has but he whose eye can integrate all the parts; that is, the poet. This is the best part of these men's farms, yet to this their warranty-deeds give no title."

The following poem brings out the same idea, and certainly places poverty not on the one who



THIS SO-CALLED OWNER A GOOD TENANT TO NATURE.

does not own titles, but who cannot really assimilate and own and possess a beautiful landscape; Emerson also proves that materially speaking, mother earth owns us, and it is only a question of time when she will take us back into her body out of which we came:

“Bulkeley, Hunt, Willard, Hosmer, Meriam, Flint,
 Possessed the land which rendered to their toil
 Hay, corn, roots, hemp, flax, apples, wool, and wood.
 Each of these landlords walked amidst his farm,
 Saying, ‘Tis mine, my children’s and my name’s.
 How sweet the west wind sounds in my own trees!
 How graceful climb those shadows on my hill!
 I fancy these pure waters and the flags
 Know me, as does my dog: we sympathize;
 And I affirm, my actions smack of the soil.’

“Where are these men? Asleep beneath their grounds;
 And strangers, fond as they, their furrows plow.
 Earth laughs in flowers, to see her boastful boys
 Earth-proud, proud of the earth which is not theirs;
 Who steer the plow, but can not steer their feet
 Clear of the grave.

“They added ridge to valley, brook to pond,
 And sighed for all that bounded their domain;
 ‘This suits me for a pasture; that’s my park;
 We must have clay, lime, gravel, granite-ledge,
 And misty lowland, where to go for peat.
 The land is well—lies fairly to the south.
 ’Tis good, when you have crossed the sea and back,
 To find the sitfast acres where you left them.’
 Ah! the hot owner sees not Death, who adds
 Him to his land, a lump of mould the more.
 Hear what the Earth says:

EARTH-SONG.

“ ‘Mine and yours;
 Mine, not yours.
 Earth endures;
 Stars abide—
 Shine down in the old sea;
 Old are the shores;
 But where are old men?
 I who have seen much,
 Such have I never seen.

“ ‘The lawyer’s deed
 Ran sure,
 In tail,
 To them, and to their heirs
 Who shall succeed,
 Without fail,
 Forevermore.

“ Here is the land,
Shaggy with wood,
With its old valley,
Mound and flood.
But the heritors?
Fled like the flood's foam,
The lawyer, and the laws,
And the kingdom,
Clean swept herefrom.

“ They called me theirs,
Who so controlled me;
Yet every one
Wished to stay, and is gone,
How am I theirs,
If they can not hold me,
But I hold them?”

“When I heard the Earth-song,
I was no longer brave;
My avarice cooled
Like lust in the chill of the grave.”

EMERSON.

CHAPTER XIII. TILLING THE SOIL.

Here's to deep-plowing, shallow-cultivation,
Tillage, manures, diversification,

Cotton a surplus crop, plenty of meat—
To Southern farmers enjoyment complete!

During the early history of man's existence on the earth, he no doubt roamed over prairies and hills and through valleys eating the natural fruits of mother earth just as other animals did. But as he grew in wisdom his wants multiplied, and soon he began to work out plans to have a variety of things to eat, all growing in the same locality. This in time necessitated moving plants from one place to another, and of gathering seeds from different places and putting them near the place he had begun to call home. The planting of trees and seeds necessitated digging in the earth, which soon led to what we know now as tilling the soil. This practice is no doubt almost as old as any other of man's practices on the earth. From the earliest records we find of man in history, he was conducting some kind of agriculture; we conclude that it belongs to the pre-historic arts. When we take this view of the matter, the mere sight of a man plowing in the field over there means more to us. Now we can see in this simple farm operation the evolution of an art in which over 40% of the human race is engaged, and one which has grown from the simplest planting of a few plants and seeds to a great and important science.

The Meaning of Tillage.—The dictionary definition we may look for, and bring to the class written out with our opinion as to whether it is complete. The word must involve at least preparation of land for planting seed and then the keeping of land in condition suited to the growing of plants. Tillage may be said to be the manipulation of the soil by means of implements. When



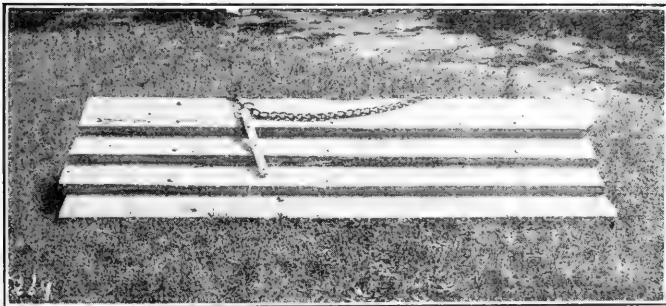
A DISC PLOW.
(Best plow for bottom lands and stubble fields.)

we do anything to the soil to improve it, or to make it a better home for plants, we are said to be tilling it.

Objects of Tillage.—Let each of us try to tell in our own language just why we till the soil. This will be a good lesson with which to supple-

ment our language lesson for the day. Perhaps the most common objects of tillage are the following three: 1st, To change the texture of the soil and thereby conserve moisture and enable the air to penetrate down to the roots of the plants; 2nd, to mix thoroughly the manures that we may apply to the soil; 3rd, to prepare thoroughly the seed bed in order to make seeds germinate better after they have been planted; 4th, to keep down weeds and grass.

We are already aware that too much or too little moisture at the roots of plants will cause quick and permanent injury. Tillage will help to regulate this water supply and give the plants a better opportunity to develop. In a later chapter we shall take up the relation of water supply to the different forms of humus applied to our lands.



DRAG.

(Under side, showing how the heavy boards are bolted together.)

Tillage Implements.—These may be divided for convenience into the following groups: 1st, Plows; 2nd, Harrows and Cultivators, and 3rd,

Drags, Crushers and Levelers. It will be well for each of us to bring in a list of implements under each heading with local names attached, and suggest in the class the use of each. Some are in the habit of calling everything that is done to the land with horses and implements, plowing. They have not learned that plowing and cultivating are two separate and distinct processes, and are done for entirely different purposes. Here is another place we can use our dictionary to good advantage, in comparing the meanings of the two words—plowing and cultivating.

Plowing.—Plowing is the process of breaking land after one crop has been made, and before



GOOD BREAKING—MOULDBOARD TURN PLOW FOLLOWED BY SUBSOILER.

another is to be planted. It is an annual or semi-annual process for keeping the land well pulverized, and should not be confused with the cultivation of the land. Plowing is a kind of turning over of the land, and turning under any rubbish or decaying old plants or vegetable matter, so that they will not be in the way of cultivating the new crop when it comes on. Plowing is sometimes synonymous with the popular term "turning" the land, or "breaking" the land.

Cultivating.—By this time we have been pre-



THE FIVE-TOOTH CULTIVATOR.

pared to realize that cultivation is a process of itself, and is quite as important to the welfare of the farm as any other process. It is whatever we do to the land to make it a better place of living for the growing plants. Cultivation, or the stirring of the soil with cultivators, harrows or other like implements is usually designed to suit the age of the plant as well as the nature of the soil. For instance, young plants whose roots

have not developed could be cultivated any reasonable depth without injury, but after the root systems have developed and covered a considerable portion of the soil under the surface, it will not do to cultivate deep, as the plants depend on the root systems for food and water supplies, and anything that interferes with the roots interferes also with the food and water supply. This is the reason why it will not do to *bar* cotton after it has developed sufficiently to fill the bed in which it grows with root systems.

CHAPTER XIV.

FURTHER STUDIES ON CULTIVATION.

Some Comparisons.—Suppose we take three small areas of land and plant in cotton or some other convenient crop. Fertilize and plant each of the spots alike, but cultivate one regularly and shallow, and leave another uncultivated as a check; and in the third plat cultivate deep all the time, from planting till *laying by* time. Take careful notes on the difference in the growth of the three plats. In this experiment, be sure to measure the depths of cultivation in each plat and at each time of cultivation, also measure the heights of plants each time. This will be quite convincing as to the value of proper cultivation.

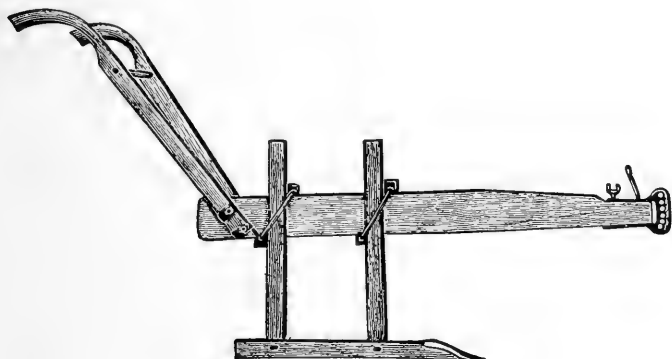
What Cultivation Really Does.—In order for plants to thrive as they should they must have a proper amount of underground air. We all know that a newly cultivated field will be more likely to permit air to penetrate the soil than a crusty surface that has not been cultivated. But each rain that comes in spring and summer especially during the growing period of the crop forms such a crust over the soft soil that it practically shuts out the air from the soil below this crust. Our crop seems to be checked in growth, and begins to look yellow if we do not get to it in a reasonably short time after the rain, and soon it becomes impossible to recover it from this check. The remedy is to cultivate as early after a rain as

possible. Cultivation then opens the pores of the soil—so to speak—and lets the plants breathe more freely in the growing period. It also creates a mulch on the surface of the soil and enables it to hold the water much longer. A crusty surface causes the soil moisture to get away in mid-summer and helps to keep the soil cold in spring. A third thing that is accomplished by cultivation is to help increase the heat in the soil in spring when the young plants first begin to grow. The crust reflects the heat while the soft newly cultivated soil absorbs the heat.

Experiment to Show Heat.—In two small plats place a few cotton seed in early spring. Keep one well stirred and let a crust form over the other. See which one germinates the seed earlier, the cultivated or the uncultivated. This result can be compared with field conditions in the community in which the test was made. See which of the farmers keep their newly planted fields cultivated and which do not. Compare these facts with the *stand* each farmer gets.

Time to Begin Cultivation.—Should this be after the young plants are already up or not? We shall claim most emphatically not. The time to begin cultivation is when the land needs it. Cultivation is a process for bettering the condition of the land in which plants are to grow, and we should keep in mind the land in which the plants grow instead of trying to watch the plant to see when it needs attention. After the plant shows that it begins to need attention, we have needlessly neglected our duty far too long. The plant should

never show lack of attention. Our soil should be so well kept that the plant cannot show lack of cultivation.



A SUBSOIL PLOW.

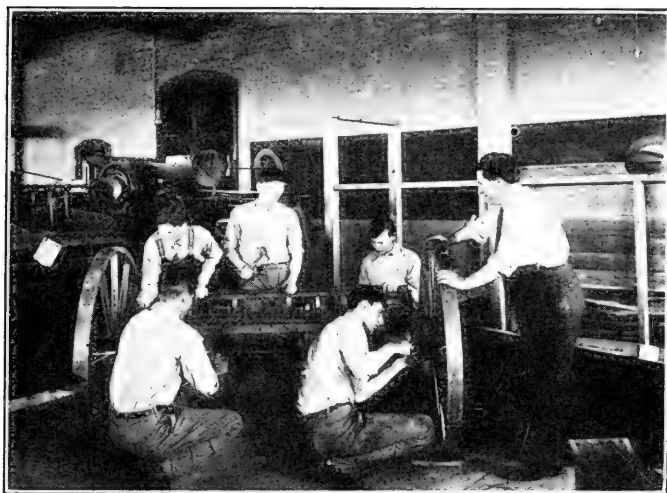
Time to Stop Cultivation.—Cultivation should be kept up so long as we can pass through the crop without injury to the plants, at least till the fruit is beginning to mature. Most people lose a big per cent of the profits of the farm by stopping the cultivation a little too early. Sometimes the last cultivation itself determines whether the farm pays or not. Do not be afraid of interfering with the growth of the plant if you cultivate shallow enough. If the last cultivations come far apart, they should aim only to break the crust and let the air down in the soil. Sometimes cultivation injures crops because farmers cultivate a little too deep after having waited too long between cultivations. This is because the roots that have come near the surface of the soil are cut and the plant therefore suffers. A very shallow

cultivation at this time will not cause this trouble.

These suggestions apply to all farm crops. Something will be said as to the best methods of cultivating each of the several crops when these crops are reached in the text. The same general laws of cultivation apply to all crops and we should not fail to go over and over these till we thoroughly understand them. Our knowledge of them will depend largely on experience with them rather than on reading about them, therefore it is quite necessary that we do something to enable us to see the truth of any statement about the cultivation of the soil.

CHAPTER XV. FARM IMPLEMENTS.

At the present time when so many farm implements are being placed on the market one hardly knows just how to begin a study of them. By the time you have learned how to use one kind of



AGRICULTURAL STUDENTS STUDYING FARM MACHINES IN DETAIL.

implement, it is out of date and replaced by a more modern and convenient one that does practically the same kind of work with much more ease and less power often. This forces us to make a study of the principles involved in the use of farm implements rather than the analysis of the instruments themselves. How many of us who

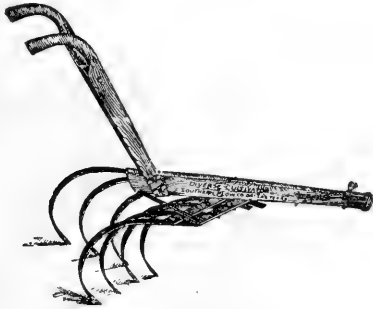
are now in the common schools remember the old Dixie Boy plows, or the still older Yankee turn plow, and yet they were all the talk when I began work on the farm several years ago.

Plows Proper.—Not every kind of implement in front of which a horse goes back and forth through the field is a plow. Suppose we turn to our unabridged dictionary for a moment and see just what a plow is, or what the maker of the dictionary decided that it was. We shall be pretty apt to find that it is an implement drawn by beasts of burden for the purpose of *breaking the land*, and *preparing it for planting*. Here the definition will stop, or perhaps tell you that it is also used to cut ditches for draining, or to subsoil with. We may conclude with safety that a plow is an implement with which we plow, and not one with which we cultivate. Each member of the class in this study should examine a disc plow, a mould-board plow, and a subsoil plow, and bring a description of each to the class. These implements are the ones that make for better farming, and should be studied.

We should visit two fields to get a good idea of the importance of proper plowing; one in which deep plowing has been practiced, and another in which only the small one-horse plow has been used. Get statistics on the yield per acre of these two fields, and bring in for a lesson in Arithmetic. We shall learn by this experience that our profits in farming depend more on going deeper into the soil than on spreading out over more acres.

Cultivators.—This term originally meant a

triangular implement set with small shares, drawn by a horse or other beast of burden and set to handles. Now it means any implement used for stirring the soil around growing plants, or for killing weeds about the growing plants. There are many kinds of cultivators, and we shall be required to examine at least two different kinds, one on the order of the Planet, Jr., and the other after the manner of the Little Joe harrow which I consider a very good cultivator for all crops in



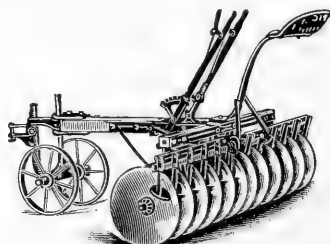
THE SPRING-TOOTH CULTIVATOR.

early spring before the grass begins to grow. We shall be able to find cultivators in any modern hardware store. A description is not necessary, because with every manufacturing concern the idea seems to be to get some small change in all implements as often as possible and hence keep up with the times.

We have often thought that all rural schools should have as part of their equipment a set of farm tools for study with classes, and be able to

give regular weekly or bi-weekly demonstrations with them. This will be required in future as much as carpenters' tools are required to teach manual training. How easy it would be for students to get an idea of the value of a certain kind of farm implement, if they could see it in operation!

Harrows.—The coming of the harrow marked wonderful progress in agriculture, and as it becomes adapted to a greater variety of uses, its services to the art will be more and more felt and



THE DISC HARROW—THE GREATEST TOOL OF MODERN TIMES.

appreciated. Harrows are essentially of three kinds, spike tooth harrows, spring tooth, and disc harrows. All of these have their special merit and all three kinds will be found on many of our Southern farms.

An accurate description of each of the three kinds of harrows should be required of each member of the class, the description being based on actual observations and then corrected and rewritten. We are often slow to appreciate how any object looks till called upon to give a description of it. Then we never forget. Do not restrict

to any particular makes of harrows, but require that they be of the classes above referred to.

What are Harrows?—A general definition would be farm implements designed to pulverize the soil preparatory to making a seed bed. There are many uses to which they are put, and we have an almost endless variety. Every conceivable shape and combination has been tried, from the wooden beam, with a few pegs driven in, to the steel frame with elastic steel teeth. Perhaps you will need several of these. Some to scratch, some to smooth, and some to cut. The object generally is to make fine the soil turned up by the plow. This work cannot be done too often nor too well.

To make dust of the soil is desirable and profitable. Often we need harrows to break the crust and destroy weeds and grass. They are great labor-saving machines. They enable one man and one team to do the work of several. Some harrows are so made as to be used in covering grain, and enable the farmer to do this very rapidly and nicely. Sometimes they have seeding and guano-distributing attachments. These machines do the work of several hands at once. Those of another form are called cultivators, and are so constructed as to greatly simplify the work of cultivating many of our crops.

Other Farm Implements.—Planting machines have almost entirely done away with hand planting. They do the work more rapidly, accurately and cheaply than can be done by hand. The new implements are so constructed as to put seed all along in a continuous row, or drop them at any

required distance in hills. By using different attachments, some of them may be made to plant almost any kind of seed.

Manure spreaders are so arranged that they grind up or tear to pieces the coarse barnyard manures and distribute them quite evenly over the fields. The work is much better done than can be done by hands and forks. Here, as in all

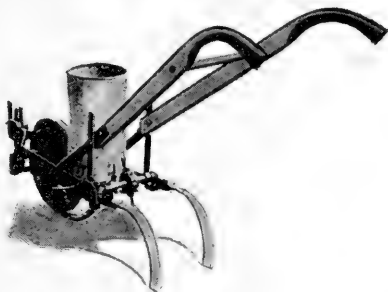


FARM DEMONSTRATION AGENTS TESTING OUT NEW IMPLEMENTS.

good machines, there is a great saving in labor.

Mowing machines, horse rakes, hay tedders, stackers and unloading conveniences are so well known and appreciated that we need only mention them as a part of the march of progress on the farm. No farmer would think of harvesting a large crop of hay by hand. Hay presses make it possible to handle hay with great ease, and greatly

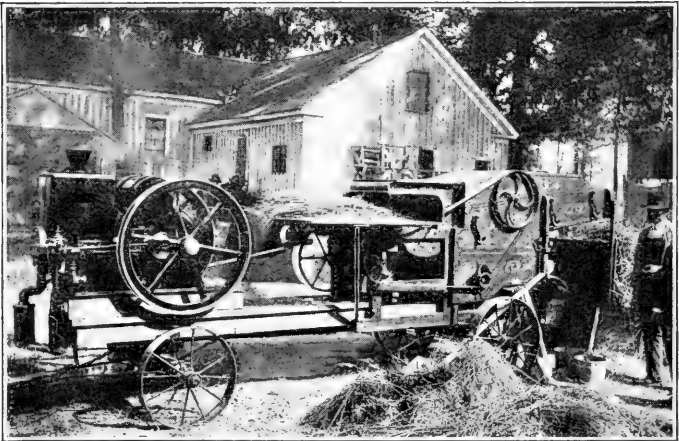
reduce the storage room required, but a cheap power press is still much to be desired. Inventive genius has done wonders in solving the question of handling small grain. From cutting with the hand sickle, separating with the flail, or horses' feet, and winnowing with the wind, we have advanced until now the grain is cut by the self-binder and delivered ready for the shock, or cut, threshed and sacked ready for the miller. These wonderful machines are run by self-traveling engines, propelling themselves and the machinery.



ONE HORSE "PLANTER."
(Drops seeds in hills or in drills.)

These are used only on large grain fields. Yet they are a part of the farm equipment possible, and affect the price of the grain produced. The handling of the corn crop is being greatly simplified. Instead of the labor of pulling the fodder and ears by hand, shucking and shelling in the same laborious way, the machine does it well-nigh all. The stalk is cut and fed to the shredder. This machine takes off the ears, shells and sacks the grain, and shreds the stalk, shucks and blades into excellent hay.

In gathering and preparing cotton for the market, comparatively little advance has been made. We still pick it by hand, gin it with saw gins, and bale it in rude packages, unwieldy and unsightly. New processes are being tried for the improvement of the bales. Inventive genius may yet succeed along these lines. As soon as the cotton leaves the producer's hands, all this is changed. The huge compress takes the bale in its embrace, and hands it out reduced in size. Thus the railroads and ship companies can carry three times as many, and the cost of transportation is thereby greatly reduced. When we enter the cotton factory, we find ourselves in wonderland. Marvelous machines, that almost seem to think and speak, manipulate this fiber of the farm into a thousand useful fabrics.



A THRESHER AT WORK ON A SOUTHERN FARM.

So we find at every step, from the hoe handle to the steam thresher, improved machinery which enables the farmer to cut down his expenses, do better work, and run up his profits. It would be just as sensible to expect the traveling public to abandon the Pullman sleeper for the old-time lumbering coach and six, as to expect the farmer who understands his opportunities to continue his old way of farming. The manufacturer could as well afford to exchange the spinning jenny and power loom for the old-time hand spinning wheel and hand-shuttle loom, as the farmer of today can afford to ignore the mower and reaper.

The Cotton Picking Machine.—This may well be considered in the list of farm implements. While the success of such a machine is not yet assured, some cotton has been picked commercially by several makes, and we have no right to doubt that their success is a possibility. Some considerable discussion has been brought about as to whether the suction picker or the spindle picker is the more likely to win out. These two principles are the only principles on which pickers seem to have been constructed, and the spindle is too destructive to the plants, and will not permit of two pickings perhaps, while the suction is too tedious and slow, though it will pick much more than four or five men. Cotton picked with the machines has to be treated differently from that picked by hand, and this fact will perhaps delay the coming of the machine into general use. It has much more trash than cotton picked by hand and therefore must have a cleaning attach-

ment to the gin before it is permitted to run through the gin.

The Dixie and the Price-Campbell are the two pickers about which much has been said and written, and they are perhaps the best machines yet invented for picking cotton. They are both operated by means of revolving spindles, which twist the cotton out of the bolls, after which a rapid moving fanner brushes it back into a holder. This holder is emptied at regular stations up and down the rows of cotton,—usually at the ends of the rows where they are short. These pickers seem to crush the cotton plants, and riddle many of them, so that it is not easy to go over the same field the second time with them, especially if the plants are in any way brittle.

The Care of Farm Implements.—Tools left out in sunshine and rain lose, in a few years' time, more in value than it would cost to build a shelter. The wooden parts very soon begin to decay. The iron and steel rust, and are thus injured. The oxygen in the air is no respecter of men or tools. Its gnawing tooth is never idle. A little care spent in keeping tools of all kinds well painted, will be found to pay well. This is particularly true of the wooden parts, but often applies to the metal also. No skill is required in doing this kind of painting. The paint can be purchased ready mixed, of any desired color. Anyone can put it on. It will pay to do this about once a year on tools that are much used. This work can be done on rainy days, or other odd times, without interfering with the regular work.

Relation of Skilled Labor to the Use of Farm Implements.—In buying new and improved implements, we must always have due regard to the intelligence of the laborer who is to use them. This consideration again emphasizes the need of a technical education among farmers. An educated brain is a power. A trained hand is valuable. Unite both of these in one man, and you have the



MACHINERY SHED ON A SOUTHERN FARM.

possibility of doing wonders. In such cases the brain gives increased utility to the machine, and the machine gives increased capacity to the brain. Machinery does not require feeding or clothing, hence it is generally more economical than hand

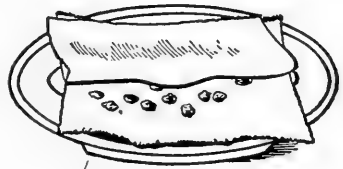
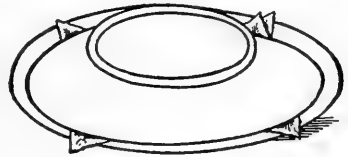
labor. If kept in order and properly handled, it never makes mistakes.

It requires more human strength and animal power to do sorry work with a sorry tool than it does to do good work with a good tool. We do not advise buying everything new that is offered, but when a tool has been tried and proven to do more work or better work, or both, if the price is reasonable, you want that tool. Always require a guarantee that the machine will do what it claims to do. The market is at all times full-stocked with failures and humbugs. Farmers have caught their full share of these *bugs*.

CHAPTER XVI. THE PLANT.

Materials.—There is no time when we shall not be able to get ample material for lessons on plants, especially if we have planned our lessons a little ahead. Several small packages of various kinds of seeds are always useful and should be on hand. They should consist of corn, cotton, beans, peas, vetch, clover, alfalfa, and as many others as can be conveniently found. Saucers, or small shallow plates, may be

used for germination tests. Try to have in the school room at all times some kinds of flowers in bloom. This will not be found a very hard task if we will take time by the forelock and plant them in boxes, jars and other vessels. No one can teach about plants without having plants present, though



DEVICE FOR SEED TESTING.

thousands of teachers have tried to actually teach about them from pictures in books, when plants were so plentiful.

In order to have everything convenient for growing flowers, we should have in addition to the above, several flower pots or boxes,—the boxes being preferable if they can be made at school by

the boys and girls. We should also have some dilute manure which should be obtained from some lane or passage way that cattle use going to and from pasture. The best form for this manure is to sweep up some earth with the manure and put in pots, after diluting with leaf-mould or some rich earth. This will grow the best flowers, and will establish a practice of making fine flowers for home use. Do not get the manure till it has been trampled into dust, and can hardly be distinguished from dust.

In early spring wild flowers can be secured for a study of parts of plants, which should be taken up as early as possible. These should be transferred to boxes and left growing just as they are found in the woods.

Parts of Plants.—All plants may be divided into the four general parts:

Roots,
Stems,
Leaves,
Flowers.

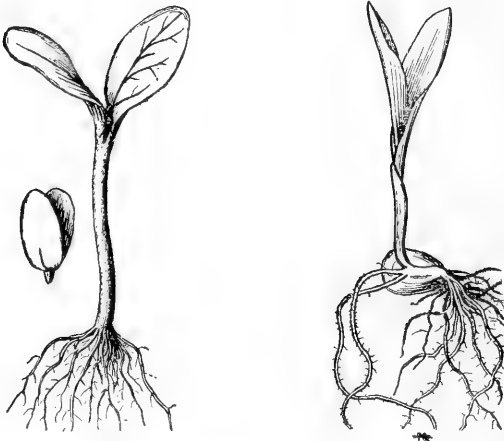
Each of these parts may be sub-divided into other parts as we may deem fit. Surely our knowledge of these parts will arouse our interests sufficiently to cause us to inquire into each part, and see what is there.

The Roots.—Place roots on the desk before us and see just how they are constructed. Who will be the first to find out if there are any very small roots fastened on the larger ones? Of what use can the plant make of these tiny little rootlets? They seem almost too small for anything, and yet

the plant owes its very life to them. See whether they cover the entire length of the roots or only part. Do they go to the tip of the root? Through the intimate union of these small roots with the soil, they are able to withdraw from the soil the minute particles of water necessary to the life of the plant. The older parts of the roots take no part in the process of absorption. The young roots of the plants absorb very little moisture except in the region of the fine root-hairs or the zone in which they usually grow.

In the water that the small roots thus absorb are carried in solution the minerals necessary for the food of the plant. No plant can take food that is not in solution. Plants do not take food into their systems that is not good for them. There may be in solution many minerals not good for the plant, but the plants exercise a choice through the peculiar selective power of the cells. The cell walls can perhaps take in every thing in solution, but living protoplasm through which the material must pass before it can benefit the plant, excludes certain substances, while allowing others to pass through more or less readily. The rejected matter is exhaled through the leaves of the plant.

Solutions must not be too strong, as they will permanently injure these small root-hairs. In fact the food that is supplied to the plant must be properly diluted, so that the roots will extend and manifest thrift, if the best results are to be secured. This should suggest the importance of properly distributing fertilizers in the drill rows,



GROWING PLANTS.

and not putting them down with drills to be left unmixed with the soil. A plant is tenderest when it first begins to grow, and any strong solution of chemicals proves detrimental to its growth and health, at this time. This question of method of putting commercial and other fertilizers in the soil will be studied again under the heading of fertilizers.

Kinds of Root Systems.—In order to study the different ways plants develop root systems, we may take before us, a root of a cotton plant and one of a corn plant. What do we find as to the essential differences of the methods of growth of these two plant roots? Does the corn plant have any central root around which there are many branches? Does the cotton? The large central root of the cotton is called a tap root. Has the corn plant a tap root? A number of plant roots should be studied in order to find out to which class they belong.

Some plants are able to gather nitrogen on the roots. Can anyone tell what class of plants has this power? Name as many legumes as you can. Something more will be said about this class of plants in another chapter. Some plants that creep along on the earth, grow roots at every joint almost. Can someone tell the name of one plant that does this? We are to collect up samples of grasses and running plants that have this habit.

Aerial Roots.—Some plants have roots that never reach the soil, but gather food for the plants from the air. These are called aerial roots. This form of roots is usually found on climbing plants,

the roots becoming supports or filling the place of tendrils. The trumpet creeper is one of the plants that has this kind of roots, and some one may bring some of it to the class. Other kinds of plants have aerial roots only and are therefore known as air plants. Among these may be mentioned the tropical orchids.

It will be well for us to try to get up with some common plant the complete root system and see just how much more extensive it is than the stem and branches above ground. This will enable us to realize the importance of having a roomy and comfortable place for the roots to grow. It will also incidentally impel us to make better preparations for the growing of better field, forest, and garden crops.

CHAPTER XVII.

THE PLANT: STEMS, LEAVES AND FLOWERS.

In this chapter we shall make general observations on the nature and growth of these organs of plants, and have a few lessons in Botany in another chapter. It must also be borne in mind that there are so many kinds of plants, and these have so many kinds of flowers, leaves, and stems that it will not be practical nor desirable to give in a short outline like the present text more than fruitful suggestions for further work by student and teacher.

The Stem.—Practically all the stems in agricultural plants can be studied from specimens taken from the fields and gardens, and this should be done. It never pays to pass over a lesson on any phase of plant life without the proper illustrative material, and we will succeed in our study in proportion to our willingness to collect such material and wisely use it.

What is the definition of a stem? Some authorities say it is that part of the plant that grows in the opposite direction to the root. This is not a bad definition. Suppose we examine several plants to see if we shall be able easily to find exceptions. The stem in growing upward is seeking light and air while the roots in their downward growth are seeking food and drink for the plant. In form the stem is generally round

or cylindrical, though there are exceptions. Pupils will be required to find and name at least one exception.

Kinds of Stems.—Stems are divided into many classes as well as kinds. We may class them according to their ability to hold themselves erect. Those that cannot do so are called vines. Those that can are divided into herbs, shrubs, and trees. This latter classification is based on the nature, duration, and mode of branching. Those that die down to the earth every year are called herbs. Those whose stems live through the year are called trees or shrubs according to circumstances. If the branches live through the year and arise from the main stem or trunk we call the plant a tree. But if the branches come from the ground or from near the ground it is called a shrub. When this gets very bushy the plant is called a bush.

We shall bring before the class a herb, and shrub, and let the class in turn go before or to the tree and study it. In Agriculture, most of our crops are herbs, though the subject has come to include forestry and horticulture, and now may incorporate all three classes of plants.

Leaves.—The leaves are the parts of the plants that aid primarily in the process of nutrition, or the proper assimilation of foods. They are also the lungs of the plants, so to speak. In Agriculture, the plants that are called forage plants have their greatest value in their leaves, and the leaves usually make the bulk of forage plants. Leaves indicate their state of health by their color, which should be in most cases a rich green.

The richness of their color is directly related to the supply of food. When the food is lacking in nitrogen, the leaves will usually show this by exhibiting a light yellowish green. The health of the plant will usually be indicated by the leaves, and we should give special attention to the needs of these important organs.

The Flowers.—The flowers are the organs of reproduction; and in farm crops they generally develop into the valuable part of the crop. All the grains, the fruit of the legumes, cotton, and horticultural products are the direct result of the flower. The success of these plants depends on the success of the flowers. Flowers are said to be only modified leaves and assume definite functions of reproduction after they have been adapted for this work.

Parts of the Flower.—Complete flow-

ers are those that have the four parts, calyx, corolla, stamens, and pistil. All others are said to be incomplete. These parts of the flower will be studied at length under the proper heading. It



USE THE COTTON BLOSSOM FOR A LESSON IN BOTANY.

1. Petal.
2. Sepal.
3. Ovary.
4. Ovules.
5. Pistil.
6. Stamens.

is important to know at this time that flowers have male and female organs, and a careful study of these organs is quite necessary to the improvement of farm crops. Ignorance of these has cost our farmers a great deal of money annually, and we should know how to save this loss. Varieties of corn and cotton are kept pure only by keeping them from crossing, and we should learn how crosses are made by wind and insects.

Let each of us bring some pollen to the class. Pollen is the fine dust that is shaken from the stamens of flowers such as corn tassels, which are the male organs of the corn. The silks which are fastened to the young cob are the female organs. Before the young grains can grow, or even form, the pollen must get on the silks. The wind usually blows the pollen into the air, and it afterward settles on the silks. This is then called wind-pollinated. Pollination may be done by hand, or by insects. Later we shall have some exercises in Botany, and shall then pollinate some flowers.

CHAPTER XVIII.

MANURES AND FERTILIZERS.

It is possibly well for us to consider here that the modern practice of applying fertilizers to our farm lands is a new thing in the development of Agriculture. Peruvian guano was first introduced into the United States in the year 1845, and the year following Mr. David Dickson of Hancock County, Georgia, seeing an advertisement of it in the old American Farmer, published at Baltimore, bought three sacks of it and finding that it paid him well, continued to increase his use of it till 1855 or 1856, "and then went into it fully". This is perhaps undoubtedly the first time that commercial or concentrated fertilizers were used in the southern United States.

Manures.—Manure is anything which has once been a part of plants or animals, or both, but is now decayed or decaying. Rotting vegetable or animal matter of any kind is more or less a manure. The word is generally used to mean the refuse from domestic animals. Hence we speak of horse manure, cow manure, sheep manure, hog manure, and so on. The general name of all these is lot or stable manure, sometimes called barnyard manure. When these substances decay they become soluble in water and then furnish plant food. Thus they cause plants to grow very rapidly. Having once been plants, they are apt to furnish all the kinds of food needed, and about the right quantity of each. The voidings from animals are rich in the

elements needed for plant-building. This is particularly true of the liquid. Hence, by using some vegetable waste, such as leaves or straw, or even sawdust, to absorb the urine, we greatly increase the quantity of stable manure. We also improve the quality. The liquids are already dissolved. The solids must become so before we are helped by them. Farmers who fail to use the liquid manure from their cattle lose the best half. The solid or liquid voidings may be kept together or separate, but neither should ever be lost. If both are preserved together, we have a perfect or complete manure, suited to almost every plant, and to every kind of soil. We have already shown that a very small amount of a needed constituent will exert a great influence in the growth of any plant. Small quantities of soluble manure may thus increase the crop. Sometimes we get two or three times the yield by adding a small quantity of manure.

The Soil in its Relation to Manures.—No part of the earth's surface may be considered soil till it has decaying and decayed vegetable and animal matter in it. Sometimes, through careless farming, this valuable material is permitted to be reduced to a minimum. This decaying matter forms the best part of the plant food existing in the soil, and forms also an invaluable material for the physical condition of the soil. The land may, however, be so treated that it will have very little of this material in it, or in fact very little plant food of any kind.

Again, there may be plentiful supplies of



NATURE'S TOOTHsome SPRING TONIC.

mineral substances, but a lack of ammonia, and the crops will be poor. Supply this need and the crops will be bountiful. A field of wheat containing fifty acres, lacking this ammonia, might only be able to yield a crop of ten or twelve bushels per acre. Use some stable manure, costing about three dollars per acre, and the yield is often run up to twenty or thirty bushels per acre. We thus have a profit of ten to twenty dollars per acre, or five hundred to a thousand dollars on fifty acres, from the use of one hundred and fifty dollars.

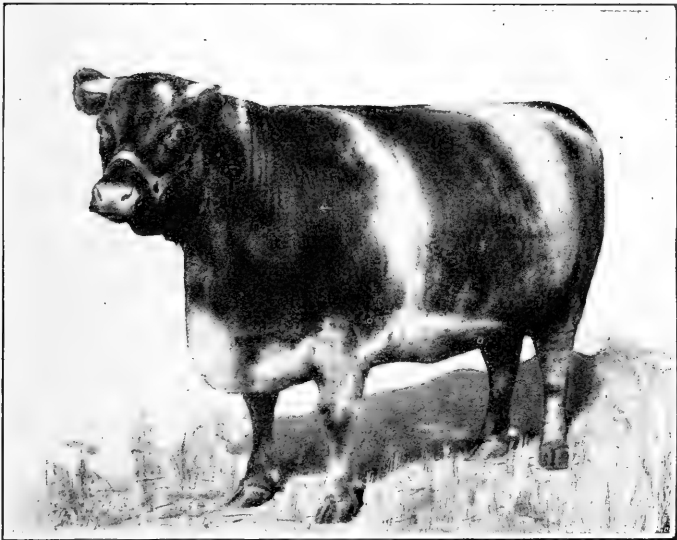
This wonderful change was brought about in part by supplying the lacking constituent of plant food, but this was not all that was done. There were in the decaying manure microbes which caused a process of fermentation to begin in the soil. This created acids and gases, which helped to decompose the plant food already abundant in the soil. But they were not soluble before, and could not be used by the plant. Now they are made soluble, and the power of the soil to produce crops is greatly increased. This fermentation changes the soil much as yeast changes the dough. Thus we get from the use of stable manures benefits far beyond the cost of the plant food in them. To get the full benefit from them, they should never be allowed to get wet, or be leached by rains, before they are put in the fields. The most soluble part is always the most valuable part. As soon as they get wet this part is dissolved into the water. If the water is permitted to run through, it carries this away with it. Millions of dollars'

worth of the very best plant food is lost in this way every year. It either soaks into the earth or evaporates into the air. In either case the farmer loses it.

Manures Should be Kept Dry.—Manures of all kinds should be kept under shelter, and only given enough water to assist in the rotting. If properly handled, the urine will generally supply this. When taken from the shed or barn, the manure should be spread broadcast upon freshly plowed ground, and harrowed in. If this cannot be done at once, then as soon as can be. Plow the ground, so as to get the manure mixed with the soil as soon as practicable. More or less loss is going on until this is done. The advantages of spreading the manure are many and important. We have spoken of the fermentation and its good effects upon the soil in turning loose locked-up stores of plant food. We can see at once that this can be done better if the manure is mixed with all the soil than if it be confined to narrow streaks and spots. Again, plant roots go everywhere through the soil, seeking food. If the supply of food is uniform, the crop will be so and the plants will be healthier. If the manure be only in the row or hill, then only those roots which are there can get any good from it. So we lose very much by using manure in drills or hills.

Another great gain in keeping manure dry is in the handling and hauling. One ton of manure will easily absorb several tons of water. Many farmers pay more in labor and in money for handling and hauling the water than the manure.

Live Stock and the Supply of Manure.—The quantity and quality of the manure depends somewhat upon the feed. Cattle take away very little from the available plant food in the vegetable matter fed to them. They consume chiefly the elements which come from the air. They add to the manure waste material from their



A MONEY MAKER.

blood, flesh and bones, which increases the value. Hay and grain foods, such as cotton-seed meal, wheat bran and oil cake, support the cow with only part of their contents. A large part of these and of all other food substances passes on to the manure heap, rich in all the elements of plant food. This

has been rendered more soluble by the processes of digestion. A ton of cotton-seed meal will give flesh to the cow and increase the flow of milk, improve the yield of butter, and furnish nearly as much for plant food after being fed to the cow as before. The cow has taken some, and added some from the waste of her own system.

It is hardly possible to keep up a high standard of fertility on our farms without the aid of cattle. The cow seems to be the cheapest guano factory the farmer can patronize. She gathers up from the highways and the byways, pastures and hedges and odd corners much that would be lost. Cattle-growing has been a leading feature of farming in all ages and countries. We might sum it up this way: Grow grass to feed cattle, to make manure, to make the land rich, so that we can grow more grass to feed more cattle to make more manure, to make the land richer, to grow more grass, and so on forever.

Green Manures.—When we plow under a growing or partly green crop it is called *green manure*. Sometimes this term is applied to stubble. In any case while barnyard manure is suited to all crops, it is not the only good manure. All decaying vegetable matter makes the soil richer. Stubble and trash of all kinds should be plowed in. They keep the soil porous and warm, as well as add some plant food. Some plants take nitrogen from the air and leave it in the soil. Clovers and leguminous, or pod-bearing, plants generally have this power. Cow-peas are very valuable for this purpose. Very

poor soils have been made rich by sowing a pea crop after a grain crop for a few years. The vines are good for manure, and help to enrich the soil, if left to die and decay on the field; but the most good is done by the roots. The vines are so much more valuable for hay that it is not good farming to let them rot. They are worth about fifteen dollars per ton as hay, and about four dollars and fifty cents for manure. It is poor economy to lose this difference—about ten dollars per ton. But we need not lose anything at all. Save the vines and feed them, and thus get the hay value in full and the manure value in addition thereto. The droppings from cattle fed with pea-vine hay are very rich.

CHAPTER XIX.

COMMERCIAL FERTILIZERS.

Animal Matter as Fertilizers.—Not only are vegetables valuable for manure, but decayed animal matter also is rich in plant food. Even the bones and hoofs and horns of animals are valuable for manuring purposes. They form the basis of many of the best guanos. Rotting fish are largely used for the same purpose. Manures and fertilizers are often spoken of as though they were the same. Strictly speaking, they are different in some important respects. Manures are the result of natural decays. Fertilizers are chemical compounds. The plant food they contain is made soluble by strong acids. Animal bones are ground fine, and the acid is added to the flour. By the action of the acid, more or less of the phosphoric acid, potash, lime and mineral elements is made soluble in water. These compounds are called acid phosphates, superphosphates, and so on, according to the quantity of the different elements. If sulphuric acid is

used, they are called sulphates. If nitric acid is used, they are called nitrates. If carbonic acid is used, then they are called carbonates, and so on through the list.

If the substance used with the acid is potash, then we have the nitrate or sulphate or muriate



THE OUTGO.

of potash. If soda was the base, then we have nitrate of soda. If lime, we have sulphate or carbonate of lime.

These chemical compounds are carefully analyzed, and the exact proportions of the different elements made known. This soluble percentage of each plant food must be plainly marked on the sack or barrel, and guaranteed by the parties selling. This is for the protection of the farmer. By looking, he can see what he is purchasing. They are generally sold by the ton of two thousand pounds. Thus, eight per cent. phosphates means that in a ton there are one hundred and sixty pounds of soluble phosphate; two per cent. potash means that in a ton you will get forty pounds of potash. In a ton of phosphate we get about these quantities of plant food—two hundred to two hundred and forty pounds. Now, if we distribute these, as is the custom, at about the rate of one hundred and fifty to two hundred pounds to the acre, we are putting on each acre about ten or fifteen pounds of phosphate, and two and one-half to four pounds of potash per acre.

We expect these small quantities to cause a great increase in yield. Often they do. We often have four to six thousand stalks of corn per acre, and ten to fifteen thousand stalks of cotton. If the roots find all we give per acre, how much potash would one stalk get? Two thousand corn stalks will divide each pound among them. Four thousand cotton stalks must feed on each pound.

Ammonia Necessary to a Complete Fertilizer.—Experience shows that, besides potash, phos-

phoric acid and lime, we need nitrogen for very many crops. This is added to the phosphate by the use of nitrate of soda, Peruvian guano, decayed fish, dried blood, cotton-seed meal, and many other substances. Plants seem to require that the nitrogen be given to them in the form of ammonia. We find this generally guaranteed on the sacks in about the same quantities as the potash—one and one-half to two and one-half, sometimes three per cent. This little change gives a new name to the compounds, and they are called complete fertilizers, or ammoniated guanos. It adds considerably to the cost per ton. It is very readily dissolved by water, and constantly tends to evaporate in the air, particularly if exposed to hot sunshine.

Guano.—Among the nitrogen group of fertilizers comes guano, the excrement of the sea birds that inhabit certain coasts, especially the western coast of South America. The use of this material as has been suggested above, was first used in the United States in 1845, but it was used in great quantities in Peru long before that country was invaded by the Spaniards. A pamphlet published in 1609 says “that no one was allowed under pain of death, to visit the Guano Islands during the breeding season, or, under any circumstances to kill the birds which yield this substance; and that overseers were appointed by the Government to take charge of the guano districts, and to assign to each claimant his due share of the material”.

Guanos differ from other nitrogen producing

fertilizers in the fact that they are natural products of the earth, produced from the deposits of millions of birds, or rotting fish bones, or both combined. They are generally found in tropical regions. They are very rich in nitrogen. This element determines their comparative value. Peru furnishes us with most of the highest grades. The name, however, is often applied to manufactured goods containing ammonia. Strictly speaking, they belong to the manures, for manures are made by natural processes; fertilizers by chemical processes.

Difference Between Manures and Fertilizers.—

There is a radical difference between manures and fertilizers, and to the farmer this distinction means a great deal. What is made by chemical processes he cannot make. This he must buy. What is made from natural processes, he can make for himself. This he need not buy. If you understand your business, you can mix your own fertilizers. You need not buy them ready mixed. Cotton-seed meal is a good source of ammonia for farms.



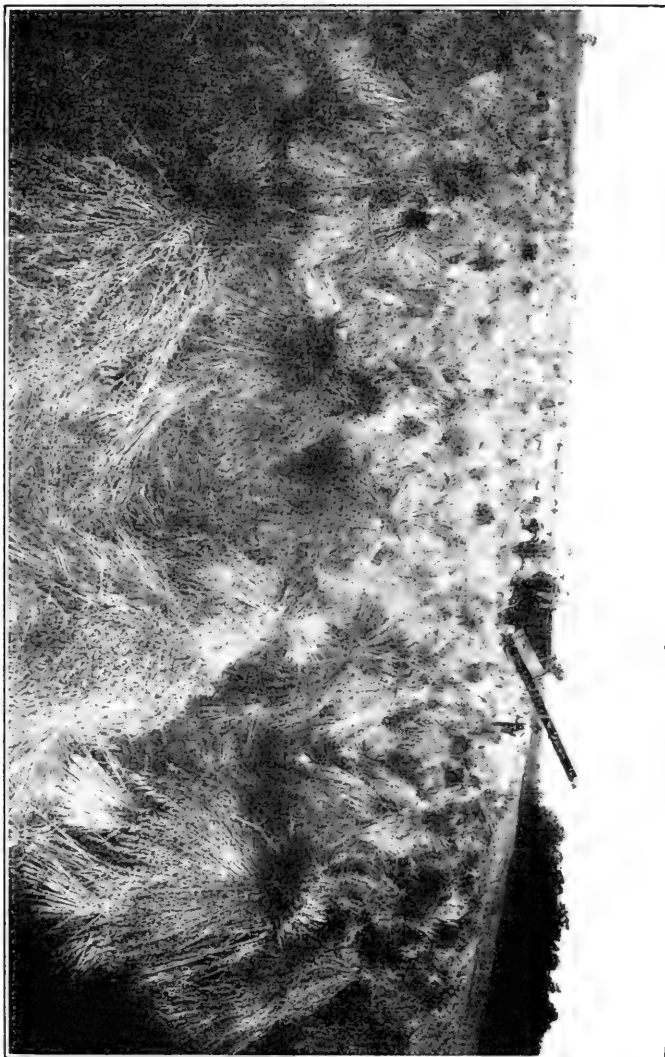
a—PLANT NOT FERTILIZED.

b—PLANT PROPERLY FERTILIZED.

But there is another very important difference between manures and fertilizers. Manures make the soil richer at the same time that they make the crop larger. They do this by constantly adding to the soil much vegetable matter which, though not immediately soluble, will soon become so by the agencies already at work in the soil, and by the fermentation which they cause to set up in the soil. Thus, by nature's own methods the work of enriching the soil goes right on, while the soil is making the owner richer year by year.

This is not the case with chemical fertilizers. They are prepared by a definite formula, and prepared to do a fixed amount of work and no more. They carry to the plant a small quantity of dissolved food. This is all they can do. We have already seen how small this quantity is. They supply in some soils what is wanting and this is all they can do. They may, and very often do, increase the growing crop. They act like the iron in the blood. They make the plant healthy and strong, so that it sends out many active roots, which feed on the soil food, and thus a heavy growth is secured; but they make very little contribution to the permanent food supply of the soil. They have rather stimulated it to extra effort, and often it is left poorer.

The long continued growth of heavy crops by the use of commercial fertilizers alone does not build up a high state of fertility. Now, we have in the first twelve inches of soil about four to eight thousand pounds of phosphoric acid, sixteen hundred pounds of potash, and from five hundred



FERTILIZER PAYS ON SMALL GRAIN AS WELL AS ON COTTON AND CORN.

to four thousand pounds of nitrogen to each acre of land. The next twelve inches have rather more of all except nitrogen. What we need then is a system of culture which will make available these vast quantities of locked-up plant food. Using chemical fertilizers does not do this. Using home-made manure does help to do so.

Chemical fertilizers are useful if properly used, and often pay a good profit on the investment, but we should never learn to depend entirely upon them. Southern farmers have enough ammonia in their cotton seed to supply not only their own needs, but to supply any farm in the United States.

CHAPTER XX.

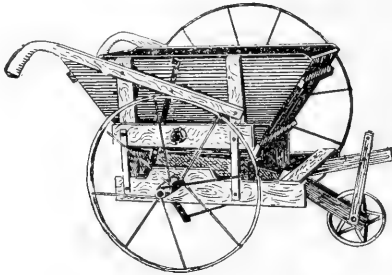
THE PROPER USE OF MANURES AND FERTILIZERS.

It goes without saying that thousands of tons of good plant food go to waste every year on account of careless methods of applying it to the soil. We have learned that manures help the physical condition of the soil as well as furnish the plant with food, and are therefore far more valuable than chemical fertilizers. When farmers realize this fact fully, they will renew their efforts to apply some manures to their land as well as to buy annually \$18,000,000 worth of chemical fertilizers to put in our Georgia soils.

Very much of the profit of farming comes from the skillful use of manures and fertilizers. Manures are generally coarse vegetable matter in process of decay. To get the fullest benefit from them, we must so direct this decay as not to lose any of the constituents of plant food. Some of these, the nitrogen and ammonia, for instance, will readily evaporate and thus be lost. Others, such as the potash, are readily dissolved and carried away with the water. But a certain quantity of water is needed to help the decaying process.

Composts.—From our dictionary we may learn that *composts* means materials compounded or mixed together. To the farmer the term suggests certain mixing of definite kinds of barnyard manures, and in the south whole cotton seed, together with some lime or acids to hasten decay. It may consist of heaps of stable manure com-

bined with other vegetable matter, mineral compounds or chemical fertilizers, or all of these at once. The object of composting is to reduce the manure so that it can be mixed more thoroughly with the soil. The mineral and chemical substances are used to absorb the ammonia, potash and other substances as the heap rots. The end in view is to get a resulting compost that will furnish all the elements of food in readily soluble condition. When these heaps are made they become very much heated, as the rotting process is slow burning. The heat at first hastens decay, but when very hot destroys the best elements of plant food.



SMALL COMPOST DISTRIBUTER.

Best Method of Applying Compost or Manures.

—The practice of having large compost heaps on the farm is about to pass away and we now find that we get better results by composting in the fields. Instead of costly work, long continued after the old style, we believe it to be better to carry the manure directly from the stalls or sheds and spread it upon the field, and if we

wish to add other substances, do so as we distribute or afterwards. It will be profitable to keep on hand German kainit, acid phosphate and gypsum, or land plaster, and sprinkle these over the manure as we clean the stalls or pile the manure under the shed. These will absorb all escaping gases. When it is not convenient to do so, nearly the same results may be obtained by mixing them in the field.

The advantage of this method is that the chemical reactions take place in the soil and help to make it loose. At the same time they cause other chemical changes in the soil itself. Another important point in the use of manures is their application as to depth. Many have contended that they should be put deep down in the soil to prevent loss by evaporation. This idea is not well founded, because the fine soil is a wonderful absorbent and readily holds all gases. Dust is the best destroyer of all odors or smells. Another reason why this is not best is found in the fact that the valuable part is the soluble part. Water tends to go down, and the general tendency is to carry all soluble elements with it. We find this illustrated in the common farm ash barrel or hopper. We put the ashes in, pour the water on top, clear as crystal. In a short while this same water runs out at the bottom but not clear. It has taken the soluble potash from the ashes along with it, and is now a highly colored lye.

So in the field the tendency is for the water to carry all soluble plant food downward. We say, the tendency, because capillary attraction and

root action very greatly modify this. But this tendency is so strong that it is safe to apply most manures very shallow. Some do the best work when used entirely on top of the soil. The only danger in shallow application is due to the fact that manure is useless without water, and the seasons may sometimes dry the soil below the manure. In such cases the manure can do no good. A safe rule is to apply all manures shallow in the fall and winter, and a little deeper in spring and summer.



ASH HOPPER; THIS IS THE WAY PLANT FOOD IS CARRIED.

The Relation of Fruiting to Proper Application of Fertilizers.—If a soil is very poor, or not rich in vegetable matter, much larger crops can be made by putting all the manures in the seed bed, because the roots will not spread a great deal. A thoroughly good seed bed is a most essential thing in the success of farming, and if the land is rich enough to cause the roots to spread to all parts of the middle, we must consider the whole field as a solid seed bed. In this case a matter of great value to the farmer is equal, thorough distribution. Every inch of soil will be filled with roots seeking food, and every inch should have food ready. If the manure is put in the drill, a strong plant is started, and calculations are made for a vigorous crop. When the fruiting season is reached and the demand for food is heaviest and every energy of the plant is strained in search of needed



THIS CORN HAD TOO MUCH FERTILIZER AT PLANTING INSTEAD
OF AT FRUITING SEASON.

nourishment, then the roots are thrust out to the middle and find a soil much poorer than that in which the plant started. There is disappointment. The plant begins to readjust. It can not secure the needed food. It throws off the young fruit. This reaction is always hurtful, sometimes ruinous. The limbs or leaves are already formed. Being tougher than the young fruit, they hold on; while the fruit falls. Cotton-growers suffer immense loss in this way. Other plants may not show the harm so plainly in the fields, but they will in the barn. The wheat grains will be fewer, smaller and lighter. Corn will give nubbins instead of full ears. If all the soil had been alike, the growth would have been healthy and the crop better—less stalk and more fruit.

Mixing Fertilizers in the Soil Essential.—Whether we apply fertilizers in the drill row or broad cast them, they should always be thoroughly mixed with the soil. As has just been stated in the paragraph above, the roots reach all parts of the soil and should find food wherever they reach. This food should be so placed that it may be supplied to the plant as the plant needs it. Strong chemical fertilizers will prove too strong for the young tender growing roots, and may retard the growth of the plant, when large applications are made. The larger the applications, the better should they be mixed with the soil.

Chemical fertilizers are always costly and the farmer should get the greatest possible good from the first crop. This he cannot do if only a few of the plant roots reach the supply of food. All plants

need most help when putting on fruit. Part of the food should always be reserved for the fruiting season. For this reason many have felt that only a part of fertilizers should be used when planting. The other part should be put in when cultivating cultured crops, and used as a top-dressing on grain or grass crops. Experiments lean strongly to this theory. Whatever the method of using, the success will be greater if the soil and manure be thoroughly stirred together.

Skill Should be Exercised in Using Large Quantities of Fertilizers.—The quantity to be supplied is an interesting question. We have already said that extremely small quantities of soluble plant food make great increase in the yield. Where a pound of potash, phosphoric acid or nitrogen has been given, to be divided among thousands of plants, the effect has been great. Does it hold true that we can increase the crop as we increase the foods? It seems to be true. Many experiments seem to show that a ton of fertilizer per acre will give a larger clear profit on the money cost than 150 pounds. Good common sense and great skill are needed in using these great quantities. There must be a corresponding increase in the depth of the soil, the supply of water, and number of plants per acre. The culture must be rapid and skilled.

With proper care there seems to be no known limit to the quantity that may be profitably used. Market gardeners and truck farmers find it profitable to cover the soil several inches with good stable manure. More than forty tons per acre are

sometimes used. After they have mixed this thoroughly with the soil, they sometimes add large quantities of chemical fertilizers. In this way they are able to grow many successful crops on the same soil in one year. The danger line does not seem to lie in that direction. Strange as it may seem, it is in many cases true that rich soils show greater profits on high manuring than poor soils. This can be understood if we remember the statement already made that soils are poor on account of bad mechanical conditions. These conditions do not give the added food a fair chance. The better crops your land is able to produce, and therefore the less it seems to need manure, the better it will pay you for high manuring. A healthy man can eat and digest a larger dinner than a delicate, sickly one.

Soil Study Necessary to Good Results.—If we do not know our soils it goes without saying that we cannot know what to supply them with in the production of crops. All crops do not need the same food. While certain of the substances already named are found in all plants, they are not required in the same quantities by each. Again, the available plant food in all soils is not the same. Put these together and we see that very different amounts of certain substances would be needed to produce the best crops. If a soil is lacking in potash, but pretty well supplied with phosphoric acid, lime and nitrogen, you need only to supply the potash and get a good crop. This would be still more needful if the crop we wished to grow on that soil were one that requires a large quantity of potash.

If two of these substances are lacking, then we must supply both. Simply supplying one would not secure a good crop. If potash and phosphoric acid are both wanting, then supplying the potash would not produce the crop. If phosphoric acid alone be added, we will not get the crop; but if we add both the potash and the phosphate, we get the desired yield.



FRUITS REQUIRE HIGH PERCENTAGE OF POTASH AND PHOSPHORIC ACID.

We have some soils in which very little of either of the four needed elements is soluble. Such soils need a complete manure. Stable manure suits such soils. Ammoniated standard guano

suits such fields. So we find that different crops demand different help. Wheat needs ammonia as well as phosphate. Oats seem to do as well with phosphate alone in the fall or at sowing time, but all grains and grasses rejoice in a top-dressing of a highly ammoniated preparation in the spring, while growing rapidly. Indian corn does well with phosphate and potash. Grapes, watermelons and other fruits and many vegetables do best with large doses of potash and some phosphate added. The cotton plant will do well with a complete fertilizer, but does not seem to care much if you leave out the nitrogen. The legumes generally get all the needed nitrogen from the air. They need potash and lime.

Home Mixing.—Every school should secure small quantities of the various kinds of plant foods and mix in the school room before classes. Pupils should then mix for themselves small quantities of a perfectly balanced plant food and apply to some small garden spot. With proper conveniences, farmers could do their own mixing to great advantage and in this way each crop can be furnished with what it needs, and nothing be lost. The separate articles can be bought very much cheaper than ready-made mixtures, and about 25 per cent may be saved in this way. Phosphate flour, potash or kainit can be bought very cheap, if taken in car-load lots, unsacked. It is true that many will not need a car load, but several farmers can join to purchase their needed supplies.

Plants do not create anything. All the growing

crops do not add an ounce to the material world, nor does their death and consumption take away anything. They only change the form of the matter. It is the farmer's place to direct in these wonderful changes, without which the world would soon die. If he does this wisely, he will be prosperous and happy. If he does it ignorantly, he will be poor and unhappy.

CHAPTER XXI.

COMPOUNDING FERTILIZER FORMULAS.

In order to get the most out of this chapter, it should be used in connection with Arithmetic. The calculations will prove more interesting and important than the pages of any book on abstract figures. Besides it will set us to thinking along lines that will enable us to improve our financial as well as mental condition, and will certainly prove a stimulus to the patronage of the school.

The Basis of the Calculations.—Formulas for fertilizers show the amount of available plant foods in a hundred pounds. For instance, an 8-2-2 formula means that the fertilizer has eight pounds phosphoric acid, two pounds nitrogen and two pounds potash available in each hundred pounds of the fertilizer. Suppose we wish to make or mix a ton of fertilizer of this formula out of acid phosphate, kainit and dried blood. We would have

8 per cent of 2,000 lbs. equals 160 lbs. available phosphoric acid.

2 per cent of 2,000 lbs. equals 40 lbs. available nitrogen.

2 per cent of 2,000 lbs. equals 40 lbs. available potash.

But the acid used will analyze 16% phosphoric acid, the dried blood 14% nitrogen, and the kainit 12½% potash. In order to get the required number of pounds of each ingredient into the formula, we divide the total number of pounds of each ingredient that is to become available by the per cent of availability guaranteed in the several raw materials used. Of acid we would require 160 divided by 16%. To

make a table, that would be convenient for calculation we tabulate as follows:

160 Available acid	÷ 16%	availability =	1,000 lbs. acid phosphate.
40 Available nitrogen	÷ 14%	availability =	285 lbs. dried blood.
40 Available potash	÷ 12.5%	availability =	320 lbs. kainit.
Dirt or rich earth required for filler.....			395 lbs.
Total.....			2,000 lbs.

Some Exercises.—Suppose the pupils be required to work out a similar problem, each pupil in the class selecting a separate problem to suit himself. One may take the problem to work out a formula for a 9-3-4 commercial fertilizer composed of acid phosphate analyzing 17%, nitrate of soda analyzing 16% and muriate of potash analyzing 50%.

Another may take the formula 9-3-3 to be worked out from a combination of South Carolina dissolved phosphate rock 15% available, tank-age 6% available, and sulphate of potash 48% available.

In the back of this book will be found the various percentages of availability of the several common fertilizers, from which at least a dozen problems should be made up.

Suggestions for Home Work.—Pupils may bring to school the names of brands of fertilizers used on their own farms, together with the analysis of same. No better way could be devised to get patrons interested in the work of the school than to have them go over this work with pupils. Before this shall be done, however, be sure that the pupils thoroughly understand the principle,

and can work out the problems without making an error.

The Problem of the Filler.—This may or may not be used to get the required analysis. It will be easy enough to get the proper analysis and then leave out the filler. This in fact should be done where we do our own mixing at home. We should bear in mind, however, that fertilizers without filler are more concentrated and should be more thoroughly mixed with the soil in order to remove any possible danger to the young plants, especially if we make applications as heavy as 400 to 500 pounds to the acre. With the exception of the extra cost of hauling and the freight, the filler would be preferable in most cases, because it does tend to reduce the strength of the fertilizer, without losing any of its value, or availability.

Organic Nitrogens.—For long growing crops like cotton, some of the nitrogen should come from an organic source, such as cotton seed meal, dried blood, tankage or dried fish scrap. This is best because the quickly available fertilizers would all be dissolved and used up or washed away before the fruiting season came on. A top dressing should always be made with quickly available nitrate, such as nitrate of soda or sulphate of ammonia.

It would therefore be best in compounding a fertilizer of this kind to let half of the source of nitrogen come from cotton seed meal and half from nitrate of soda, or a like combination from some of the other organic and chemical nitrogens. In making this calculation, we should bear in

mind that if we wish 20, or 30 or 40 pounds of nitrogen to the ton available, 10, 15, or 20 pounds should come from one source and the same amount from the other, and proceed with the work just as above, remembering that on account of the different analyses each amount must be worked out separately.

CHAPTER XXII.

SOME OUTDOOR EXERCISES WITH FERTILIZERS.

Most school exercises in fertilizers are conducted with flower pots or other vessels that hold a small quantity of soil and in which fertilizers may be inserted in any required quantity and proportion. This is an excellent method of showing before a class just how different plant foods affect the growth of plants. There are methods of doing work out doors that will prove interesting and as conclusive as any tests that can be made with pots.

Materials to be Used.—For a test of this kind we must have some of the following fertilizers: Nitrate of soda, sulphate of ammonia, cotton seed meal, muriate of potash, kainit, acid phosphate, and slaked lime. We need have but small quantities of these for school tests and fertilizer companies will be glad to donate small quantities to the schools that will carry out the experiments.

We should have a small area of about one-twentieth of an acre at the disposal of the school, and divide this up into small plots of 8x16 feet or some convenient form so they are all of uniform size. In order to have room for plants to grow, the plots should not be less than eight feet wide. The land should be medium and average soil for the community in which the school is located, and should be divided up into at least ten small plots or divisions, as follows:

- Plot No. 1. For no fertilizer. (Check plot.)
- Plot No. 2. Nitrogen only.
- Plot No. 3. Potash only.
- Plot No. 4. Phosphoric acid only.
- Plot No. 5. No fertilizer. (Check plot.)
- Plot No. 6. Nitrogen and Potash.
- Plot No. 7. Nitrogen and Phosphoric acid.
- Plot No. 8. Potash and Phosphoric acid.
- Plot No. 9. Nitrogen, Potash and Phosphoric Acid.
- Plot No. 10. No fertilizer. (Check plot.)

These plots should be fertilized every year just the same, and should be the basis for many lessons in Arithmetic. Pupils should work out the yield of each per acre basis, and the cost of each on the same basis, also the net gain and the total cost. In addition to these, they should have two plots of the same size on which they can test the value of barnyard manure as compared with field peas in the building up of soil. On one they should apply barnyard manure and on the other plow under field peas every other year, and the alternate years plant some other crop and apply the same amount of commercial fertilizer to each plot.

It should be impressed upon us the fact that a test is worth more the longer it is conducted, and there should be some permanent record of such tests kept in some convenient place in the school room, so pupils can consult it with the least effort. As for the amounts of each of the above to apply, this should be worked out by pupils, on the basis of so much per acre, only it should be the same amount each year, when once this has been settled.

Crops.—The crop to be planted on such an area would be determined mostly by the location of the school. In Georgia, it should be corn and

cotton in the Coastal Plain and the Piedmont section, and wheat, oats, rye, and other small grains as well as corn in the hilly section and the mountains. The same crop need not necessarily be planted every year on the same place, but the same crop should be planted on all the plots in any given year, so that we could compare the value of the different kinds and combinations of fertilizers for the same crop. In fact this would be the only way we could compare the results with any degree of satisfaction.

Application of the Fertilizers.—The amounts of the various fertilizers should be carefully weighed out and calculated on the acre basis some days before the application and stored in small sacks made by the girls. The sacks can be made out of yellow homespun which may be obtained for about 7 or 8 cents per yard, and it will take only two or three yards. The sacks can be made about 8x12 inches, so they will hold quite enough for the tests. When the time comes for application, the pupils should carefully scatter the given quantities over the plots as uniformly as possible, keeping the dates of same, each year, and cultivate in order to mix thoroughly with the soil.

Keeping Results.—Some difficulties will be experienced in getting these plots looked after in the summer months while there is no school in session. This can be arranged for, however, as it is being done in many places, by giving the results of the plots to one of the boys who lives nearest the school if he will keep them clean and cultivated during the summer. The results them-

selves should always be collected in and measured or weighed as the case may be, by a committee of the class that is making the tests. This committee should be appointed by the teacher or elected by the class or school.

There are many ways of conducting tests of this kind, and we should never neglect an opportunity of learning lessons of this kind by observation rather than by a mere text book. Pupils may remember some things in the text, but they can never forget the lessons that are learned by observing some simple lessons in soil fertility. If teachers prefer to experiment with pot cultures instead of plot work, they may do so with the greatest ease, letting the boys of the school make the boxes out of boards about three-quarters by eight inches. The boxes should be not more than ten inches square at the top. When such tests are made in pots, the fertilizers may best be applied by first dissolving them in water, and pouring gently into the soil in the boxes.

CHAPTER XXIII.

PLANTING OR SEEDING.

Preparation.—The crop we wish to plant will suggest in a measure the details of how we are to prepare the land, but there are some general principles that apply to all crops alike. One of the most important considerations for a planter is the preparation of the seed bed. If this is properly done and care taken in planting, a good crop is generally assured. Then how shall we go about preparing our land for planting? We must realize that the conditions for plant growth, deep plowing and fine harrowing, and the weather have a great deal to do with our success or failure. Most of our crops need a deep mellow seed bed. To fail to provide this is to fail in our crop production.

We should then, according to the best practice, plow our land deep in the fall in order to prevent winter washing. This will also help us to get rid of the insect life that winters in the soil, and will retard the growth of fungi that may be lurking in the soil, and waiting for the new crop in the spring.

In Case of Winter Cover Crop.—Should we break our land deep in the fall as suggested above, and wish to put a winter cover crop on it, we may do so and thereby save much of our plant food from leaching out during the winter rains. This will, however, necessitate deep plowing again in the spring, unless our winter cover crop is expected

to make our regular field crop for the coming spring. That is, if our winter cover crop should happen to be oats, and we expected the oats to ripen in the spring, we could not, of course, plow the land again in spring, at least till the oats had been taken off. A winter cover crop is always to be recommended and will in every case more than pay for the extra cost of seeding. When the practice of putting in winter cover crops is more general, our rivers will not be so red and completely charged with our good Georgia soil.

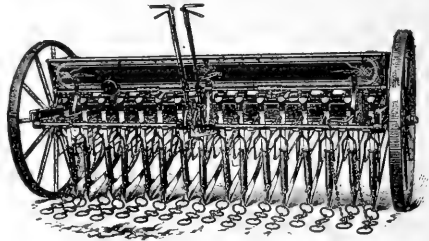
Bedding in Spring.—Before bedding our land for spring planting, it will almost always be necessary to run over it with harrow and loosen and level it. This being done, we are ready for planning our rows. If for cotton we will lay off rows about four, or four and a half, or five feet apart, and begin to prepare our seed bed. If our fertilizers have been broadcast over the field, our bedding will be very simple. After opening, we shall only list and bed and then level the bed. Then we are ready for planting. This bedding softens up the land and permits the warmth of spring to enter and aid in germinating the seed.

If Fertilizers are Put in Drill Row.—If our land is moderately poor, better results will always be obtained by putting the fertilizers in the drill row. This statement is confirmed by many experiments. In this case, after we have made the furrows, we put the fertilizers and manures in the rows, mix thoroughly and incorporate them with the soil and then list and bed as before. Level down the rows and we are ready for planting.

Many farmers do not mix fertilizers with the soil, but drill it with a distributor in the bottom of the drill row and cover it. This practice does not insure the best results, as the roots of the young plants find these concentrates too strong for them, and cannot prosper till the fertilizers have become dissolved.

Whatever we plant and however we prepare the soil, we should always thoroughly incorporate the fertilizers with the soil if we wish to get the best results.

Putting in the Seeds.—A rule that we should always observe is to not put seeds in soil that is too wet or too dry. If we do this we shall meet



THE SEED DRILL SECURES A PERFECT STAND.

with success, other things being equal. If the soil is mellow and has the proper amount of moisture, the seed will germinate very quickly, and we will have a good stand of plants. Planting is usually done with a planter, or drill of some kind, as machinery has taken the place of most hand work in recent years. Most seed should be planted shallow when put out in spring: cotton about one inch, corn from one inch to two inches, and most vegetable garden seed much shallower than this. Many seeds are lost by planting too deep. Others are fed to birds, or perish by sunshine, because they are not covered, or too lightly covered. Small grains, generally, should be covered from three-

fourths of an inch to an inch and a half. They may come up outside of this range, but they will do nothing. The shallow-rooted plants will be apt to be killed by winter freezes. The deep-rooted will perish, because they can not stool or joint.

Time of Planting.—Farmers do not seem to realize just how much it means to plant at the right time. Usually failure results from planting at the wrong time. Seeds seem to have a sort of sense of timeliness. Many of them will not germinate till the proper time comes. Grain crops, if sown too early in the fall, are liable to be injured by the autumn droughts and insects and fungi. They may also grow too much before winter begins, and then be ruined by the freezes. On the other hand, if sown too late, they cannot develop sufficient roots to resist the winter freezes. To know just when to sow each crop is, then, a matter of great importance. Of course, this varies very much in different localities. Each man must study this question for his own surroundings. Much the same is true of spring-planted or annual crops. Some of these need a long growing period. Others need a rapid growth. Hence some should be planted early, others late when the soil is thoroughly warm. The nature of the plant and the condition of the soil are important considerations on this point. A happy medium is generally safe.

Influence of Moon on Time of Planting.—Why should not a word be inserted about this since 75% of the farmers feel that their crops

are made or lost as they are planted on dark or light nights?

Many think the moon's phases are important. They tell you with great confidence that you must observe the moon and plant accordingly. This advice is contrary to science. The moon's phases are never the same two successive days as regards any particular locality. There are no quarters of the moon. All of the moon is there all the while, but what we can see of the half receiving the sun's rays changes constantly, and not at stated periods. Again, these people do not agree among themselves. Take the trouble to keep a careful record and you will soon find that they advise differently. But the question is at last one to be settled by experience, and not by argument. Experience shows that the plants do not observe the phases of the moon, but grow according to the intelligence and industry of the grower.

This is a superstition of the Dark Ages handed down from sire to son. It is noticed here because it has such a strong hold upon the popular mind.

CHAPTER XXIV.

THE CULTIVATION OF THE SOIL.

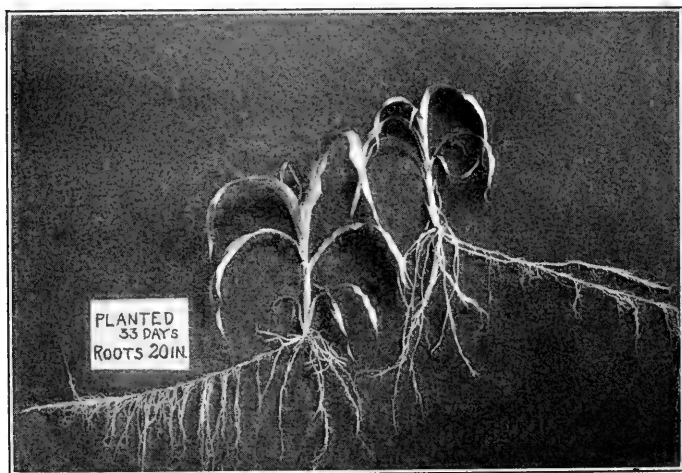
Cultivation Related to the Crop.—Note should be made here that cultivation is meant for the good of the crop, but in order for this to be, we must pay particular attention to the crop we are cultivating. There are a few general laws of the soil that must be considered and given attention in our methods of cultivation, and beyond this the implements used and the time of cultivation will be determined by the crop we are cultivating. It is safe to say that no more important work is ever done on the farm than the proper cultivation of the land.

When to Begin Cultivation.—A farmer should make it a rule never to cultivate merely to kill weeds, but for the larger purpose of controlling moisture in the soil and for improving the crop he is cultivating. It would be proper to begin cultivation of the soil whenever expedient for the purpose of keeping the soil thoroughly mellow and loose, especially after the seeds have been planted. This means that we should not wait for the young plants to come up. Often we let the seed rot in the ground by failing to cultivate after spring rains. Closely woven soils will remain cold and clammy much longer than cultivated soils, and we should see that our seed beds in spring get all the warmth possible.

The Relation Between Cultivation and Soil Temperature.—There should be a soil thermom-

eter in every school to impress this lesson. Such a thermometer would cost only a small sum. Two small plots should be selected in some convenient place and the one left untouched after breaking in the winter. The other should be cultivated as early as practicable. The temperature of each plot should be recorded daily or every other day, to see how they compare. The lesson should be impressed that the sun is storing energy in the one, which will be needed a little later, while the heat is being withheld from the other.

Cultivate Shallow.--No question is asked oftener than this: "How deep shall we cultivate?" If the soil has been thoroughly prepared, cultivation should never be very deep. It may be deeper, however, in the beginning of the season than later,



TAKE CARE OF THE ROOTS AND THE TOPS WILL TAKE CARE OF THEMSELVES.

for the reason that the soil is not full of the plant roots early. As the roots begin to grow and spread through the soil we should cultivate shallower and shallower till we reach a minimum of about one and a half inches. In this upper space the young roots should never be permitted to grow, as the cutting of them will injure the plants. To keep the roots from growing in this surface space, we shall have to cultivate often.

How Often to Cultivate.—The best answer to this is, as often as the land or the crop will be benefited. This will depend largely on the weather conditions. It does not pay to wait too long after a rainy season to cultivate. In June, crops grow very rapidly, and the tender roots will soon fill the soil, if it is not cultivated. Besides, in order for the plant to enjoy the best health, the soil must be loosened up after each rain, for letting air down amid the roots of the plants. In dry weather, moisture is preserved longer by frequent cultivation, and water is more rapidly evaporated in wet weather by frequent cultivation. So, in either case, the more frequent cultivation, the better for the crop.

How Late to Cultivate.—Some farmers have a certain part of a certain month that they call *laying by* time, after which they do not cultivate. This is not a good idea. The state of the weather, as well as the progress of the crop should determine when we cease to cultivate. The last cultivation very often determines the margin of profit to the farmer. We should cultivate, therefore, as late

as we can conveniently go up and down the rows till the fruit of whatever crop we are planting begins to set. We should of course bear in mind that the later we cultivate, the shallower we must cultivate. This lesson cannot be too well learned.

The Tull Theory.—The Tull theory, “Culture is Manure”, has been well-nigh proven to be true. Under its magic touch, soils which have been thought very poor have proven very rich. If culture does not make manure, it certainly makes the manure do much greater good. By culture we mean stirring the soil so as to keep the top fresh, prevent all baking and destroy all objectionable growth. These hurtful weeds are so many and grow with such vigor that the farmer must be ever on the lookout for them. They slumber not, neither do they rest. By night and by day they spring up and choke the crop. There are not many crops that can be planted and left alone. They require constant help. As soon as the seed sprouts and begins to grow, noxious weeds do the same.

The warm sunshine and spring winds tend to form a crust on the surface, thus preventing free circulation of air, water and sunshine, all of which are needed to prepare food for the tender roots. So this crust breeds weeds and hurts plant roots. It must not be allowed to remain undisturbed. Rapid work is now demanded. The plowman’s merry whistle should trill upon the morning air before the dewdrops have been kissed away by the sunshine. His mellow song of sweet content should wake the echoes after the roseate sunset

hues have passed away. Early and late he must speed the plow upon its mission of help and life. Care should be taken to injure the roots of the growing plants as little as possible. Hence light-running plows and harrows should be used. "Often and shallow" is the motto.

Cultivation for Forming Mulch.—We should get some outside information on the formation and importance of mulch. The kind of mulch we are speaking of here is a dust blanket. The surface of the soil in this condition acts in many ways for the good of the growing plants. It absorbs the sun's heat, but feeds it slowly to the root bed. It absorbs the dews, but prevents rapid evaporation. It assists in bringing up the



CULTIVATOR OR WEEDER.

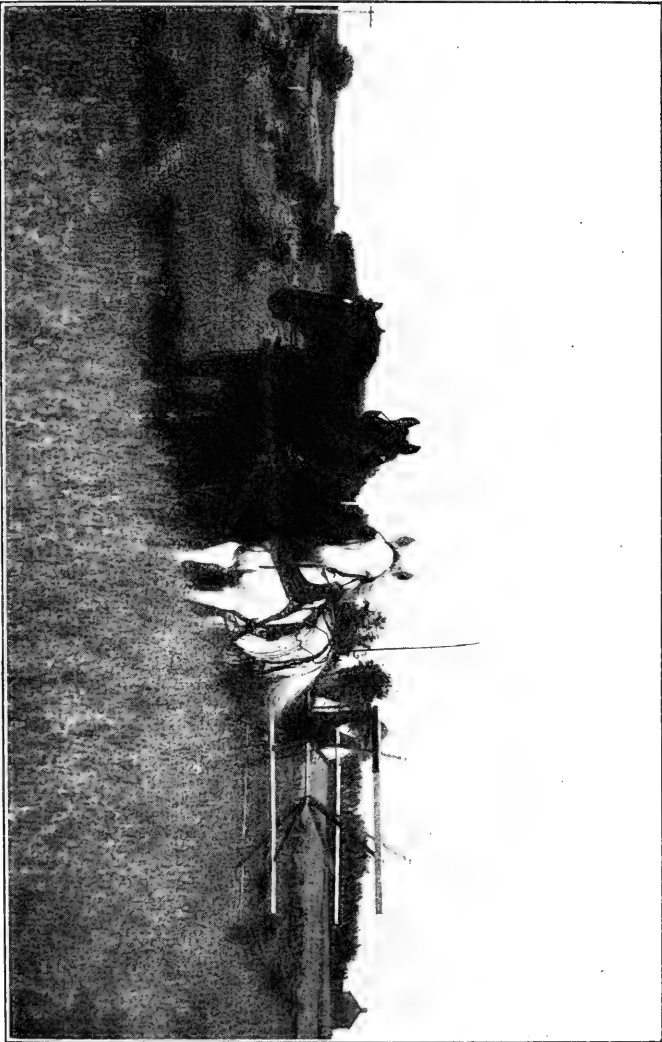
earth water by capillary action, and at the same time prevents it from escaping into the air. In these and other ways it helps forward the rapid growth

of the crops. The finer it is, the better it can do all of this work. Hence furrow after furrow is the price of success. Just before the corn comes up, run a light harrow or weeder over it. This will help to get a good stand, and destroy the first crop of weeds.

When the corn is a few inches high, repeat the harrowing. Follow with a hoe, thinning to a stand and leaving every stalk free to grow. About a week or ten days after, go over it with a cultivator or sweep. Continue this until the corn is

in silk. For cotton the culture is much the same. If a crust forms after planting, go over it with a light harrow. This helps to let the young cotton through, and at the same time kills the first crop, or coat, as we call it, of crab grass. This is the great enemy of the cotton plant. *Grass seed can not come up in freshly stirred soil.* There must always be a small or thin crust on the ground before crab grass will come up. Hence, we must stir the soil often and thoroughly to keep down the grass. When the cotton has been up long enough for the second set of leaves to appear, harrow thoroughly or plow close up with scrape, and chop out to a stand as rapidly as possible. The quicker this is done the surer the crop. Very many object to this statement, but a long experience is on this side.

Relation of Cultivation to Disease.—This paragraph may well be introduced by showing the relation between a sore finger and a well finger. Which one will be the more likely to be inoculated with disease germs that float in the air? A young plant, especially a cotton plant, will resist the diseases common to this plant much better if not wounded than it will if it is scarred by a hoe or plow. In cultivating young plants, therefore, we must be careful never to wound or scar them and thus leave an opening for disease to enter.



MODERN MACHINERY THE HOPE OF THE SOUTHERN FARMER.

CHAPTER XXV.

THE HARVEST TIME.

In view of the many millions of dollars lost annually by farmers who fail to care for their crops after they have already made and cultivated them, it will be well for us to make a close study of the harvest time, and see if this great loss cannot be saved.

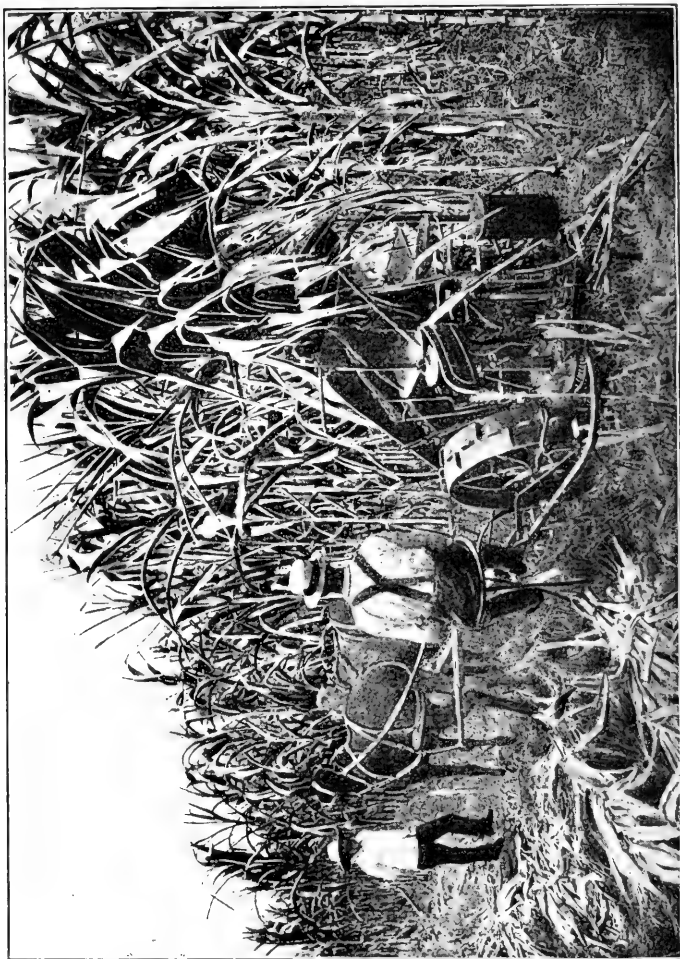
The Small Grain.—There is more pleasure in the ingathering than in the outlaying. The harvest feast and the harvest song are as old as history. The sweltering days give rich reward. The small grains will come first. When the golden tint is well set and the firm grain is in the head, the mower, reaper, sickle and scythe are heard in the land. If the grain is for hay-feeding, cut just as the dough stage is reached. If for grinding, then it should be fairly ripe. If for seed, then thorough ripening is best. Grains, wheat particularly, make whiter flour if reaped before too heavy a coat of bran is formed. Local surroundings will decide whether the reaping shall be done by hand or machine.

After the grain has been placed in dozens and well capped, it should stand until thoroughly dry, if the weather will permit. If you are dependent upon the traveling thresher, it is well to have plenty of barn room. In such cases it is always safe to house as soon as dry enough. Storms or continued rainy spells can soon ruin or greatly damage the crop. Here “an ounce of prevention

is worth a pound of cure." Some find it cheaper to provide weather-caps of duck cloth, each corner weighted, and put these over the shocks or hand stacks. They save the hauling and attendant waste and handling.

The Problem of Caring for the Straw.—The straw is too valuable to throw away, and will help the land wonderfully, if it is merely scattered over and plowed under. If it is to be fed to the cattle, a straw rack will be a great saving. Build a long shelter and board it cheaply. Have it about thirty feet inside and about nine feet high. From the middle have peeled pine poles, placed about four inches apart, and ending about three feet above the ground on either side. Have an open driveway, about eight or ten feet, running entire length. On either side of front, build a chaff room. Have a floor six feet wide running along over the wagon way.

Place the machine so that the straw will be discharged by the stacker on the six-foot floor. A man with a fork can easily distribute it along on the poles on either side. When the threshing is over the straw and chaff will be ready for feeding, without more handling. Light gates or doors can be used, if desired. The cattle can feed themselves at night and be shielded from all bad weather. The manure will be dry and ready for the field. Any kind of hay may be thrown into this rack. It is a great labor-saver as well as food-saver. The grain should be at once placed in rat-proof, weevil-free bins. A little care will so build them that rats can not get in. If the grain



A CORN HARVESTER.

is dry and kept so, weevils are not apt to appear. Heat hatches them and moisture creates the heat. A little air-slacked lime sprinkled over the grain will absorb the moisture, and help to prevent weevils.

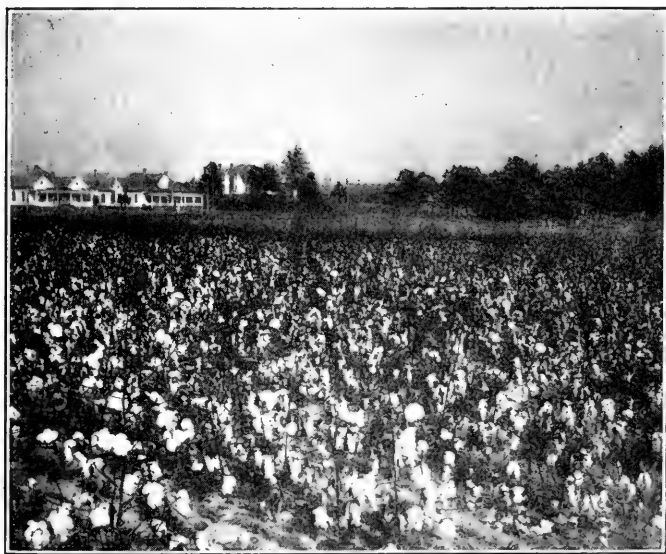
Harvesting the Corn Crop.—There have been many ways recommended for gathering corn. The old way of pulling fodder in July and August and the corn in the autumn we need not mention. Fodder-pulling has long been a regular part of farm work, but we have learned in recent years that this is not the best way to care for corn, and we have also learned that hay is cheaper and better than fodder. We have also learned that the stalk is as good for hay as the blade. The increased value of the hay resulting from using stalks as well as blades is leading farmers to quit pulling fodder and corn in the old way. We note when the grain is beginning to harden and the fodder is fully ripe, but not all burned, and then cut the stalks and stack them in fields four weeks or more. When the corn is dry we haul it in, and with a shredding machine shuck off the ear, and grind the stalk, shuck and fodder into hay as good as the fodder alone, and three times as much of it. Animals eagerly devour this hay, and do well when fed on it.

We have thus saved a great deal of labor and expense, and gathered a much larger crop of food from the same area. This plan is new in the South, and will be somewhat slow of adoption. The cost of shredders, and engines to run them, is the chief difficulty. This can be met in two ways. Either

club together and buy one outfit for several farms, or let the man who runs the traveling threshers run a traveling shredder. The corn stalks are worth as much as the corn. Why, then, should we lose them, as we have been doing? Saving is as important as making, and often much easier and more profitable. Bale the hay and care for the corn, and you will have a larger clear gain. But if you prefer the old way, the fodder should not be pulled too early, as it is the lungs of the corn plant, and stops all work in the stalk when taken off. Pulling fodder always makes the grain lighter. Put the corn away in the shuck, a little damp, mix a little lime to keep rats out, and use carbon bisulphide for weevils. The annual loss from rats is enormous, running up into millions of dollars. Build good cribs, rat-proof, and then use *rough on rats*.

The Cotton Crop.—For a long time we have been looking for a cotton picker with which the increasingly large cotton crop could be gathered without so much delay, but up to this time, as has been stated in another chapter, this picker has not been perfected. It is to be hoped that some genius will yet work out the problem. Cotton that stands in the field rapidly deteriorates in value, and should be picked as early as possible after it opens. However, we should say in passing that picking cracked bolls is not wise. If the weather is good, this growth will be finished in three or four days. There is no gain in leaving the open cotton after this. All chances considered, it is well to keep up with the picking. The hand-

ling after picking is quite important. The common custom of putting the cotton in the wagon as it is picked, and unloading it at the gin, is objectionable from several points. The cracked bolls being still damp, the lint will be cut off in lumps, and the sample will be either gin-cut or nappy, or both. Such bales never bring the



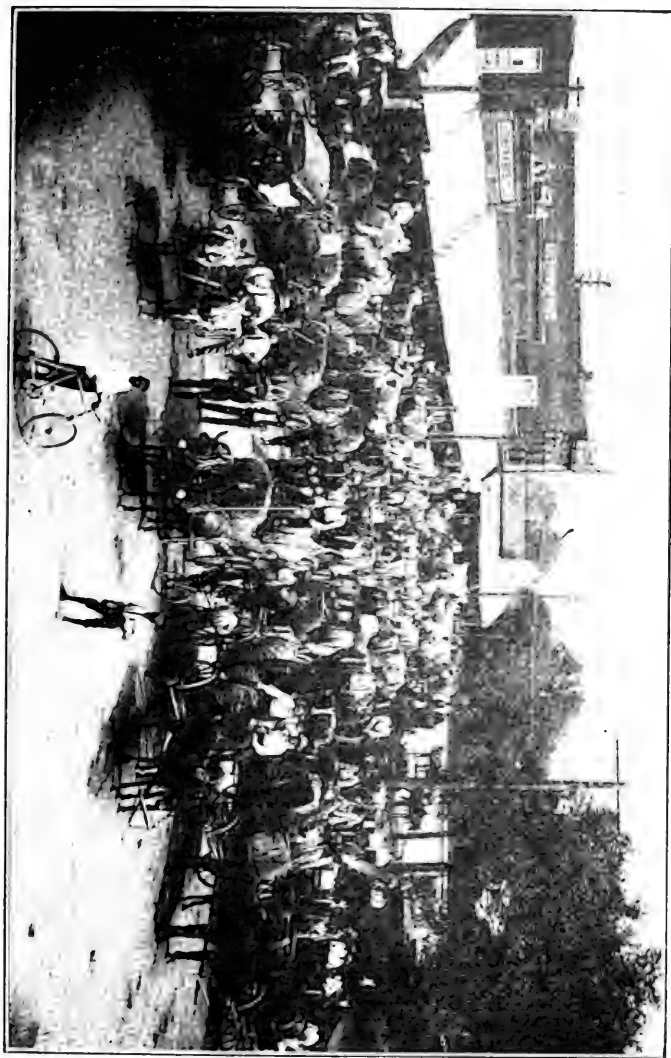
MODEL FIELD OF COTTON FOR ORDINARY UPLAND.

highest market price. Add to this the trash due to careless picking, and you have one cause for the loss of millions of dollars every crop.

The Baling of Cotton.—As cotton is our greatest money crop in the South, we should pay special attention to see that we lose none of its money

value after it has been grown and picked. Careless packing causes a great loss. There is no more unsightly thing thrown upon the market than the average bale of American cotton. The known uncertainty as to uniformity of quality necessitates repeated samplings. Each of these leaves an ugly scar, and causes a loss of weight. The size and weight make the bale awkward to handle, and the rough, heavy covering not only catches all sorts of filth, but is worthless at the factory, and is deducted in pricing. All these causes result in a loss of about two dollars and seventy-five cents per bale. With a ten million bale crop this would mean twenty-seven and a half millions of dollars. This vast sum could be saved by changing the method of baling. It is hard to change a well established custom, but when about one-tenth of the value of each crop is lost, it is worth while to do something. The round-bale system claims to do this, and is certainly worthy of the careful study of every cotton planter. Another fearful loss is caused by the old method. Having no suitable cotton house, and carrying the cotton directly from the field to the gin, encourages the idea of carrying the bales from the gin to the market. In this way the cotton crop is annually sold on a forced market, while the staple is known to be green and damp, and constantly losing in weight. The buyer must defend himself against all of these detriments, and hence the bulk of the crop always passes from the producer's hands much below its real value.

Sweet Potatoes.—The only general suggestion



SELLING COTTON.
(It is rushed to the market 100 fath.)

that can be made about sweet potatoes is to thoroughly dry them before putting them away. If this is not done, they will spoil. Some planters dry them out thoroughly before storing and then sprinkle a little water over them when stored. We should be careful not to dig them before they are ripe, nor can it do any good to leave them in the field after maturity. It is a mistake to be governed entirely by regard to frost in the matter. By cutting a potato and letting it dry, and noting the color of the dried milk, we can tell whether it is ripe. If the milk dries white, they are ripe, otherwise, they are not. When this is the case they should be dug, regardless of frost. Many methods have been tried for preserving them after gathering. We shall not select among them. Remember the nature of the potato and act accordingly. They are full of water. Much of this must escape or they will not keep. Never cover them closely until most of this water has been dried out. Soon after heaping them they will get very warm in the effort to throw off this excess of water. When this sweating is over, you may cover them with any convenient covering, as earth or cottonseed, or put them in a warm cellar. They are very easily injured by cold and must be kept warm. First dry, then warm, and they are safe. A little vegetable heat will be developed every warm spell, so a small opening should always be provided for its escape. In extreme cold spells this should be closed.

Irish Potatoes.—Irish potatoes form another valuable crop. They differ in their nature from

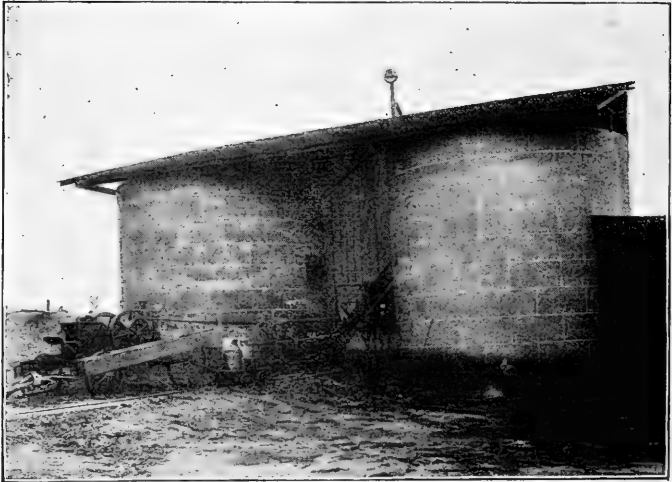
sweet potatoes. They are not easily affected by cold, but are strongly inclined to sprout if warm. The two essential points in keeping them are: First, keep them in the dark; second, keep them cool. Light causes them to sprout, and in this condition cold ruins them. Prevent this, and they are very hard to freeze. All bruised tubers should be removed a few weeks after digging. They may be kept in boxes or barrels, in the barn, covered with hay, or in the hills like sweet potatoes, but with lighter cover-



WHICH POTATO SHOULD WE CHOOSE—THE SMOOTH, EVEN
KIND, OR THE KNOTTY ONES?

ing. A moderately cool, dark room may be cheaply built for them.

Silage.—It will not be necessary to go into detail about many other crops. We may suggest that no system of farming in the South will be complete when the Mexican cotton boll weevil covers all the cotton States, that has not a good strong live stock feature, and this will necessitate the growing of silage. A crop composed of half corn and half sorghum makes a good silage crop.



THE SILO—A GOOD FACTORY.

In order to store silage, a good silo has to be constructed. The accompanying picture shows a silo that ought to cost only about \$100. Where a farmer does his own work under wise guidance, the cost could be reduced. The importance of silos will be discussed in the chapter on Live Stock.

CHAPTER XXVI. CROP ROTATION.

There is no section of the United States in which rotation is so much needed and in which so much good will result as the Cotton States. The practice of a one-crop system has about exhausted the soil on millions of acres of cotton lands, and this may be partly redeemed by a good system of crop rotation. It will cost more to do this now than it would have cost several years ago, and if not undertaken immediately will cost much more even in the future than it will at the present time. A crop rotation must be inaugurated in self defense on every Southern farm where it has not already become part of the system.

What is a Crop Rotation?—This should mean more than merely one crop following another. For a little study of the subject we should consult Bailey's Cyclopaedia of Agriculture and several other manuals on Agriculture. A firmly fixed system of farming by which the most can be gotten from the soil and at the same time the most left in it, would not be a poor definition. Wherever a one crop system has prevailed in this country or any other, the land has gradually become poorer and poorer, whether the crop was cotton, corn, tobacco, hemp, wheat or any other crop. A rotation system is therefore a system of Agriculture where there is a logical succession of crops for making money and building up land at the same time.

Advantages of a Rotation.—It has already been stated that a one crop system is a great barrier to progress in that it depletes the land. A rotation system has this advantage over the one crop system, that it helps to maintain the fertility of the land. With good land farmers will always prosper, but with poor land they cannot. Therefore, a rotation system brings prosperity to a section soon after it has been introduced. It helps to control disease and insect pests. It helps to control the growth and multiplication of weeds, and therefore saves some of the expense of cultivation. This has been clearly shown in farm practices.

How to Plan a Rotation.—In planning a rotation, consideration should be given to the three following items: the money crop, the crop that helps maintain fertility and build up soil, and the crop that helps to keep the land clean. It may be possible to combine two of these in one; for instance, the money crop may help to keep the land clean. This would be true in a section of the country where hay is the money crop; for hay usually helps to keep the land clean. In Georgia at the present time, attention should be directed especially to the soil building part of a rotation. This means that more legumes should be grown and turned under when possible. The most profitable and economic soil builders for the South are leguminous plants, such as field peas, soja beans, velvet beans, and the clovers and vetches. The hairy vetch is one of the best soil builders and will keep the land covered during



THESE ARE WINTER GROWING CROPS THAT PAY THE FARMER AND HELP THE LAND.

winter and can be cut early enough in spring to be followed with corn or silage.

A Good Rotation for Southern Farmers.—It will hardly be necessary to suggest that cotton will for a long time to come play a big part in any rotation system on Southern farms. This being true, we should so plan our rotation. Cotton is a long growing crop, and will require almost the entire year to grow and harvest it. Therefore, plans should not be made to follow cotton with winter grain crops, unless we wish to sow the grains between the cotton rows before the cotton is all picked. Winter grains can much more easily come after corn, as all the corn may be harvested in time to sow the winter grains early enough in the fall.

The order of the rotation for convenience should be as follows:

1st year, cotton,

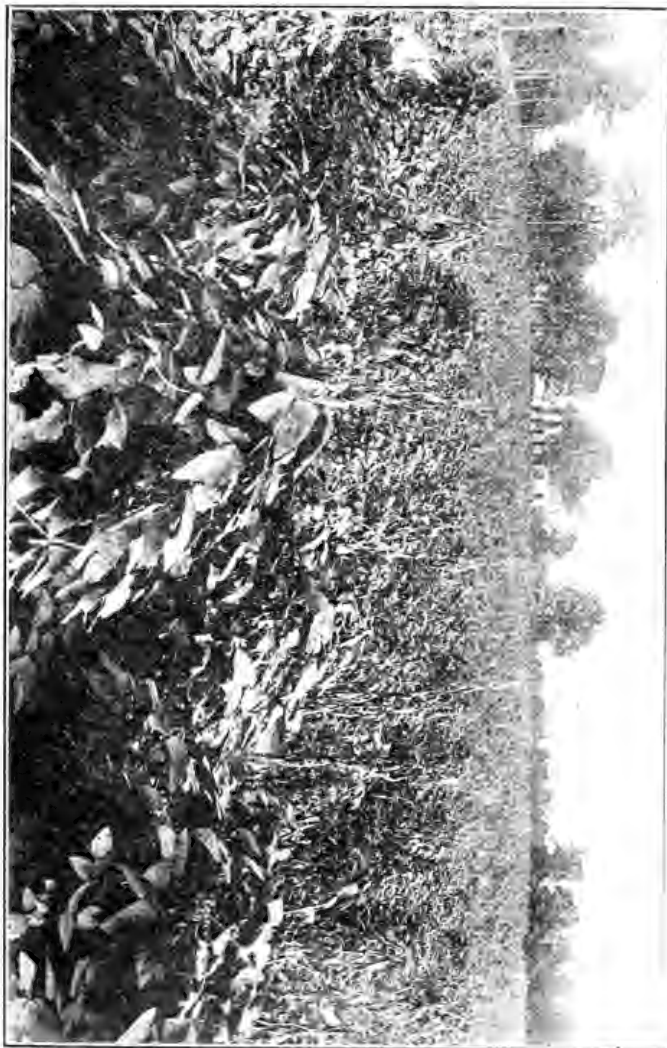
2nd year, corn,

3rd year, small grain followed by some legume in the spring.

With this order of the rotation, it would be expected that the small grain crop should be planted in the autumn after the corn had been harvested.

A Two Year Rotation.—If a farmer has sufficient pasture for a permanent supply of forage and grass, and wishes to alternate his corn with his cotton crop, this may be done with greater profit in the long run than to have a certain part of the plantation in cotton all the time and another in corn year after year. In so doing, he may be

VELVET BEANS—THE SOIL BUILDERS OF THE SOUTH.



able to cover the land after corn with some winter crop such as clover or rye, for foraging purposes. This would save the land from leaching during winter rains, and help to keep a fair amount of vegetable matter in the soil.

If he is primarily a livestock farmer, he may alternate corn with clover, or peas and oats, and thereby build up his land to a high state of cultivation. By using the barnyard manures produced by the livestock, he will be able to enrich his land very rapidly.

Conditions Affecting a Rotation.—In planning the rotation, attention should be directed to the following factors if we wish to succeed: the number of hands engaged in the work of the farm, the crops we are to plant, the teams at our disposal, the implements, and the money allowance to run the farm. We should also pay special attention to the proper division of the farm. If it has poor and rich spots, it may be divided equally according to the yielding capacity of the various fields or parts. Very often conditions may arise whereby we could not plant a ninety acre field into three equal parts of thirty acres each. This may not give us enough corn for our livestock nor an opportunity for growing silage. It is best always in planning a rotation to allow for such possibilities, and not make an iron clad rule. These considerations should not induce us, however, to set aside the real object of the rotation: viz., to permit one crop to follow another in regular succession in order that the best results may be secured.

CHAPTER XXVII.

LIMIT OF PRODUCTION OF FARM CROPS.

Some Suggestions.—Students will provide themselves with special note books for recording information of the high yields of farm crops in the South and throughout the United States. They may be required to make a special table of the yields of all the winners of prizes among the club boys and girls of the State in which the school is located. This should be done. If we need references we must write to the State Agent in charge of Boys' and Girls' Clubs, who keeps on file all the information we need.

We must also get in this note book all the highest yields we can find in the newspapers, and that our parents can tell us about. In every possible case, be sure to get the names of growers, and then write to these if they are living.

We must also get the methods pursued in the making of large crops. If we can get this and apply it, there is no reason why any of us should make low yielding crops.

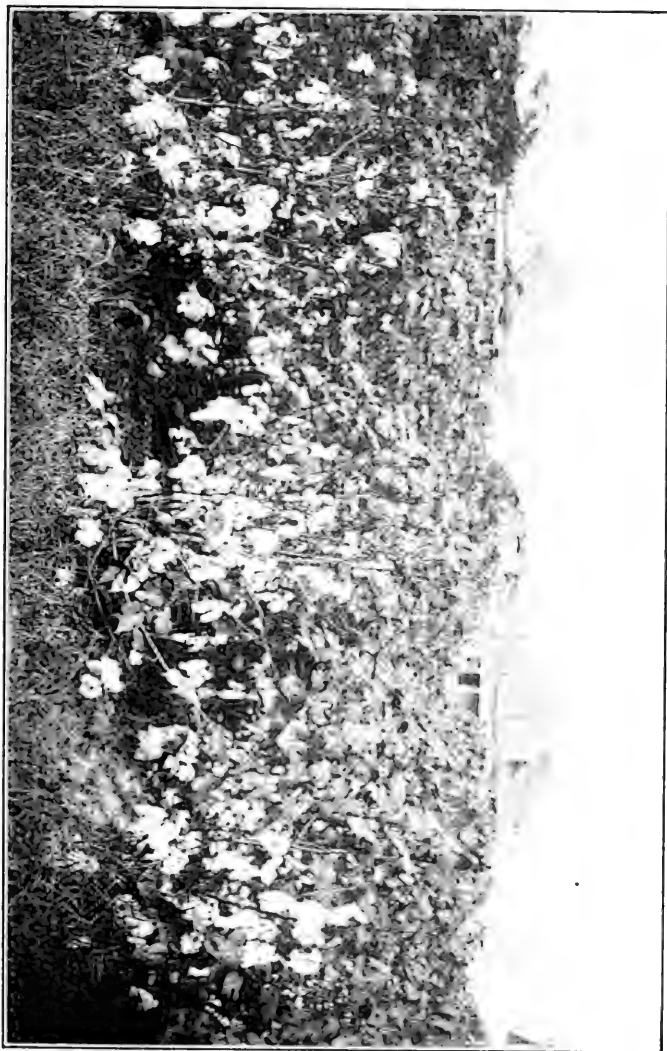
Sometimes the high cost of high yields makes it impracticable, and this is especially the one thing that we must learn. Learn the cost of production. When the grower has not made any estimate, be sure to find out the special preparation, the extra amount of fertilizer, and the extra number of times the crop was cultivated, and then estimate the total cost.

How to Make Large Yields.—If you are to

undertake to make large yields of any field crop, or in fact any crop, study the conservative and sensible methods. A study of Agriculture in the schools is one of the means of getting needed information to the farmers who are to make a living out of the soil, and certainly the subject should bear a direct relation to a new era of prosperity on the farm. If three acres could be made to produce as much corn as five acres produce at present, and at a much smaller cost, we would not only be saving land, but would be learning the value of our land—both that which we cultivate and that which we do not cultivate. The class will now show much land we would have for pasturage if the State in which the school is located would make as a whole as much corn on three acres as it now makes on five acres. Many problems of this nature can be worked out by all of us.

High Corn Yields.—Until recently, there have been very few efforts to make record yields of this great food crop, and yet since the new movement of Boys' Corn Clubs has taken such a hold upon the people of the whole country, our boys are beginning to show us how to really make corn. Many of them have made a high record of over two hundred bushels on a single acre at the low cost of less than twenty cents per bushel. If this is possible on one acre, it must be possible on more than one acre, and farmers should learn to grow their entire crop of corn on a very few acres.

Our habit of growing corn as well as other



THREE BALES TO THE ACRE AT A TOTAL COST OF \$49.00.

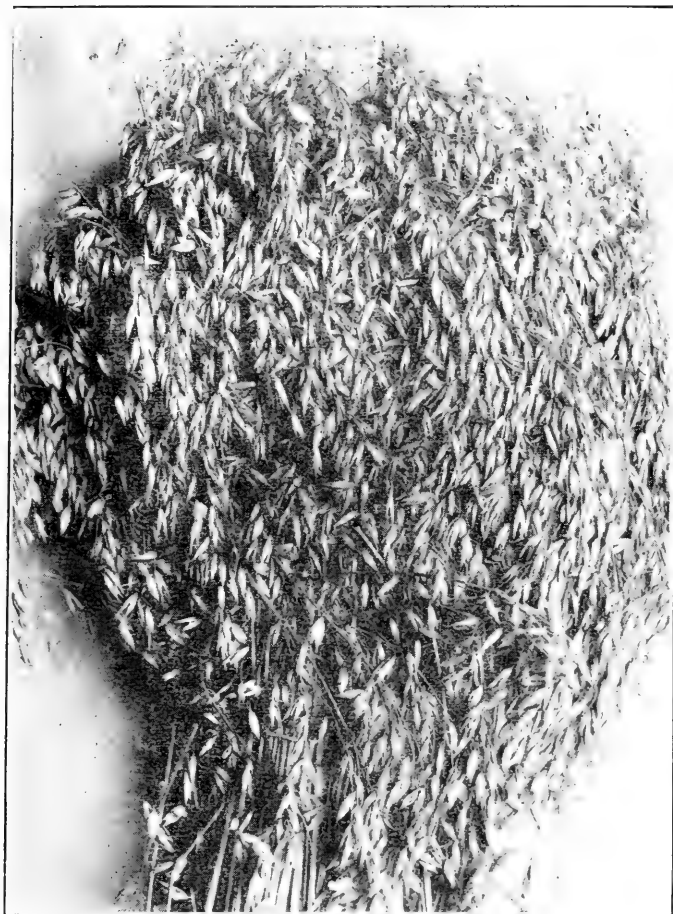
crops in the old way has kept us from making the best use of our lands. It has helped us to destroy much of our lands and we must turn the tide in the direction of prosperity, by increasing the yields of our lands.

Cotton.—As far back as 1825, we find farmers making high yields with cotton. In 1857 we find a farmer at Athens, Georgia, making two bales to the acre, and it is no uncommon thing for farmers to make as much as two and a half bales at the present time. To do so demands careful preparation, fertilization, and cultivation. All of these things cannot make two bales, though, without attention to the kind of seed we plant. A cotton farmer in Alabama wrote Dr. S. A. Knapp the following letter which will perhaps explain why we do not have more farmers who make high yields: “I was born in a cotton field and have worked cotton on my farm for more than forty years. I thought no one could tell me anything about raising cotton. I had usually raised one-half bale on my thin soil and I thought that was all the cotton there was in it in one season. The demonstration agent came along and wanted me to try his plan on two acres. Not to be contrary, I agreed, but I did not believe what he told me. However, I tried my best to do as he said, and at the end of the year I had a bale and a half to the acre on the two acres worked his way and a little over a third of a bale on the land worked my way. This year I have a bale and a half to the acre on my whole farm. If you do not believe it, I invite

FRAGRANCE AND BEAUTY AND A PROMISE OF HEALTH AND PLENTY.







A PRIZE SHEAF OF OATS—PLACE EXHIBITS LIKE THIS IN THE SCHOOL HOUSE.

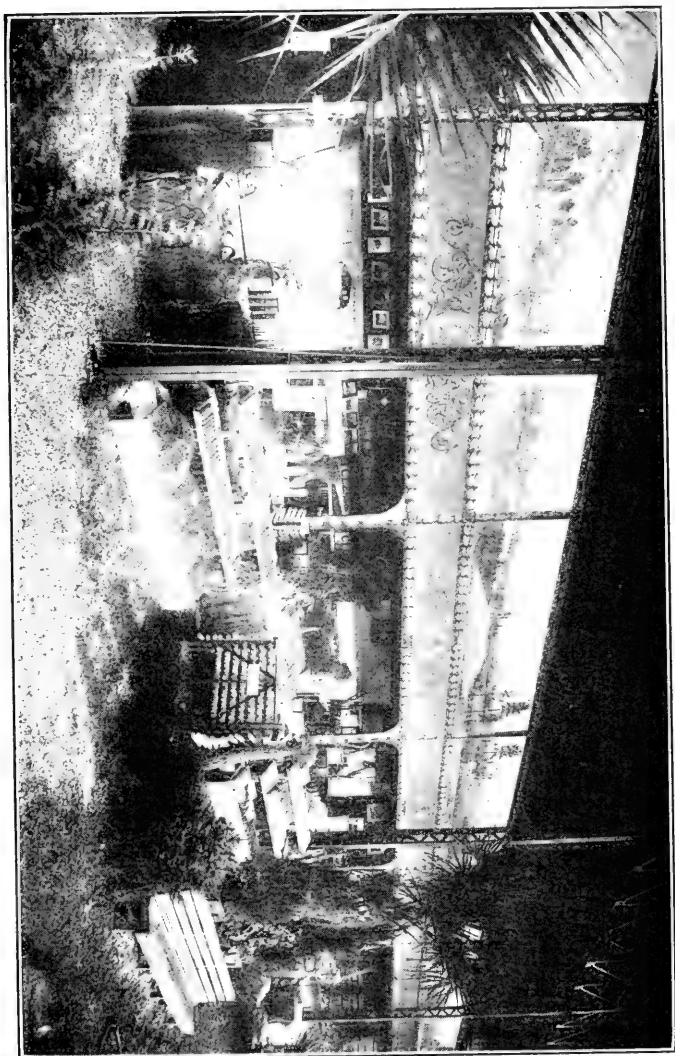
you to come down and see. Yes, sir; as a good cotton farmer, I am just one year old.”

Cotton is an easy crop to make, but we must carefully plan a big crop if we wish to make it. We must have faith in the best methods, and then practice them. Yes, indeed, we must actually practice them before we can have results.

Tomatoes, Potatoes and Other Crops.—Most of us raise a large crop per acre of these truck crops because we prepare our land and fertilize it well. Most of the spare fertilizers on the plantation go into the small patches and truck crops. If these were a little larger, and we raised these crops for sale, they would pay far better in proportion to the acreage than the staple crops.

Small Grain Crops.—It is no uncommon thing for farmers to make forty, fifty or even a hundred bushels of oats to the acre, and this being true, certainly no farmer has any excuse for raising no more than the small present average in Georgia or other of the Southern States. Get your last census report and calculate the average yield of these as well as the other farm crops per acre in your State, and in your own county if it is given. The census report may be obtained from Washington, D. C., through your Congressmen, and this experience will be of great benefit to teacher and pupils.

Let each of us bring to the class at the next meeting, as near as we can find out, the yield per acre of these crops made on our own farms. If we cannot get at the exact figures, get as near them as we can. Do not permit ourselves to



THE NATIONAL CORN EXPOSITION. THE FAIR IS A RECOGNIZED FACTOR IN MODERN EDUCATION.

exaggerate. The yield is usually less than we had thought.

Some Suggestions Given by Dr. Knapp for Making High Yields.—The following should be learned and put in practice by every student of Agriculture in school or college, and until they are, no very high yields are going to be made. The rules given below are given by Dr. Knapp in his bulletin on Co-Operative Demonstration Work.

- (1)—Prepare a deep and thoroughly pulverized seed bed, well drained; break in the fall to the depth of 8, 10, or even 12 inches, according to the soil, with implements that will not bring too much of the sub-soil to the surface. The foregoing depths should be reached gradually.
- (2)—Use seed of the very best variety, intelligently selected and carefully stored.
- (3)—In cultivated crops give the rows and the plants in the rows a space suited to the plant, the soil, and the climate.
- (4)—Use intensive tillage during the growing period of the crops.
- (5)—Secure a high content of humus in the soil by the use of legumes, barnyard manure, farm refuse, and commercial fertilizers.
- (6)—Carry out a systematic crop rotation with a winter cover crop.
- (7)—Accomplish more work in a day by using more horsepower and better implements.
- (8)—Increase the farm stock to the extent of

utilizing all waste products and idle lands of the farm.

- (9)—Produce all the food required for the men and animals on the farm.
- (10)—Keep an account of each farm product, in order to know from which the gain or loss arises.

Attention to such suggestions as those above must result in a greater and more prosperous Southern Agriculture, and let us hope that none of us are unwise enough to fail to put them in practice.

THE CORN SONG.

Heap high the farmer's wintry hoard!
Heap high the golden corn!
No richer gift has Autumn poured
From out her lavish horn!

Let other lands, exulting, glean
The apple from the pine,
The orange from its glossy green,
The cluster from the vine.

We better love the hardy gift
Our rugged vales bestow,
To cheer us when the storm shall drift
Our harvest-fields with snow.

Through vales of grass and meads of flowers
Our ploughs their furrows made,
While on the hills the sun and showers
Of changeful April played.

We dropped the seed o'er hill and plain
Beneath the sun of May,
And frightened from our sprouting grain
The robber crows away.

All through the long, bright days of June
Its leaves grew green and fair,
And waved in hot mid-summer's noon
Its soft and yellow hair.

And now, with autumn's moonlit eves,
Its harvest-time has come,
We pluck away the frosted leaves,
And bear the treasure home.

There, when the snows about us drift,
And winter winds are cold,
Fair hands the broken grain shall sift,
And knead its meal of gold.

Let vapid idlers loll in silk
Around their costly board;
Give us the bowl of samp and milk,
By homespun beauty poured!

Where'er the wide old kitchen hearth
Sends up its smoky curls,
Who will not thank the kindly earth,
And bless our farmer girls!

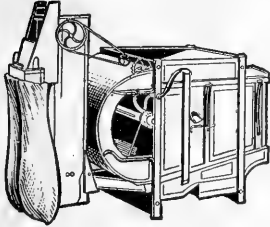
Then shame on all the proud and vain,
Whose folly laughs to scorn
The blessing of our hardy grain,
Our wealth of golden corn!

WHITTIER.

CHAPTER XXVIII.

PRACTICAL LESSONS IN PLANT BREEDING.

Selection.—The most important thing to learn about plant breeding is that selection is far safer and surer of reward than cross-breeding for most of us. To do cross-breeding successfully takes many years' experience as a breeder and much expert knowledge of the laws of heredity.



A FANNING MILL. IT CLEANS AND GRADES THE SEEDS.

We should therefore restrict most of the practical work in breeding to selection.

The Plant-to-Row Method.—After we have made several selections of plants from the general crop in which we are doing breeding work, we should not put the fruits of these plants in one heap, but should keep and plant them in separate rows, in order to see of the entire number which prove to be as good as they look. Sometimes a plant will deceive us, by looking far better than it really is, and we cannot see its defects till we have planted the seeds. In this method, each plant should be numbered and planted in a row separate from all the other selections, so that we can make what we may term its “performance record”. The selection that makes the best performance record will be the beginning of our new crop as soon as we can grow enough seed from it to plant our crop.

How to Find the First Plants.—Go into any field you will, and you can find good plants, medium plants, and poor plants. Good plants are those that are above the average in every way. Most of us can recognize them when we see them, and a little practice will make experts of us. No field is so poor that these good plants may not be found in it. No variety of cultivated plants is so poor that it does not have many good plants in it. In order to begin the work of selection, we should go into the field determined to find at least fifty good plants for a beginning of our breeding work. Teachers will find it very interesting to take classes to the field for a study of this individuality in plants. It will surprise us to find it so conspicuous.

Plot Arrangement.—This part of the work has been a hindrance to many of us who would otherwise have undertaken some simple work in breeding. The plot arrangement should be as simple as any other part of the work. The seed from one plant should be put in a separate row. The selection of fifty plants would necessitate the provision of as many separate short rows in which to grow the seed. If it proves inconvenient to grow the selected seed in a separate field or plot, we shall find it easy to arrange to put them in a corner of the regular field planted in a like crop. If we have selected corn, plant our selected ears in a corner or side of the regular field. If we have selected cotton, put our selections in one corner of the regular cotton field. One thing we must do, viz., make the selections, and begin the breed-

ing work. The plot arrangement will take care of itself.

In the Case of Cotton.—It has been complained that it is too hard to get small quantities of cotton ginned. This claim is a just one, but we should not be deprived of the pleasure of improving our

cotton, on account of this small difficulty. If several neighbors find it impractical to secure a small hand gin, plant the whole lock in a hill, without pulling the lint off. This is being done by thousands of farmers, and it works almost as well this way as when the cotton is ginned. If the plant that is selected is a very fine one, break the locks in two parts and make two hills out of each in order to get a larger area



UNIFORM PLANTS IN "PLANT-TO-ROW" TEST.

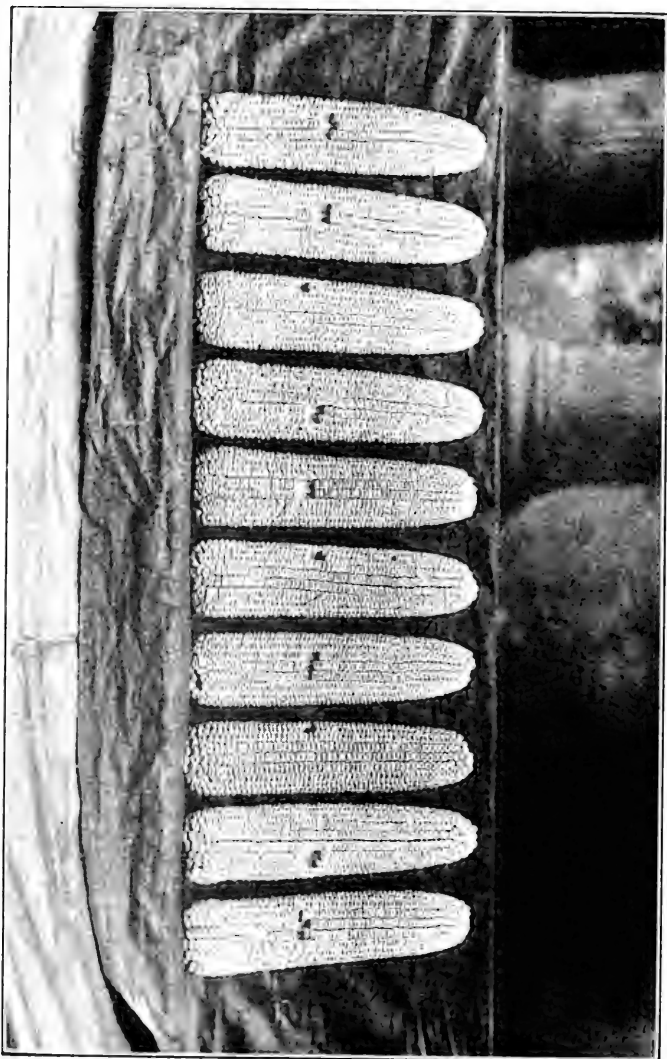
planted from the seed from one plant.

Variation.—The basis of selection is the peculiar inherent character in all organic beings called variation. If there were no variation there would be no possible way of making selections. And

if such selections were made, one could not be told from another. No two things in all nature are exactly alike. When we set up a standard of excellence, we examine many individuals and select those that come nearest our standard of excellence. The offsprings of our selections will also be variable; but the variation though as great as any plant in the field, will in most cases vary around the good points found in the selected mother plant, and this is what makes plant-breeding by selection possible.

Selection and Disease.—In many instances selection against disease in farm crops has proved successful, and we are therefore made to believe that some plants in every variety and family resist diseases better than others. When any well-known disease develops in our fields, we should make every opportunity to test the non-diseased plants for resistance. In many cases we shall be pleased to find that certain of our selections shall prove successful.

Class Work in Breeding.—Each member of the class should be required to select at least one ear of corn, of a given variety, and let the class as a whole make a test of the ear-to-the-row method, and then appoint a committee from the class to do the testing and weighing in the autumn for the class. These figures should be brought in for study the following term of school. The pupils should weigh the ears, count the number of rows of grain, get the length of ear and the distance around, the size of the cob, and put all this down in a set of notes. Then a germination test



MORE CORN LIKE THIS WILL MEAN MORE AND BETTER FEED STOCK

should be made for each ear by the pupil who selected that particular ear. This will be best done by making a shallow box, say three inches deep, and fifteen inches wide and six feet long. Cracks should be left in bottom for ventilation. This box should be filled almost full of clean sand, and ten grains from each selected ear planted in a row the short way across the box, and the sand kept moist till the corn is all up. The results will show the per cent of the grains on the several ears that will germinate. Some grains will not germinate at all, and in some, five, six, seven or eight grains will germinate. If any germinate only five or six grains, it would be well to throw this ear out from the selection, and let the pupil who selected it select another ear and test again.

Another short exercise that will prove interesting to classes is to have the pupils bring in several plants from some field and put them in a line in some convenient place in the school room, and study variation for a day or two. This will prove to all that some plants are better than others, the keynote to success in breeding.

Breeding No New Thing.—We should not be persuaded that we are undertaking something new when we undertake breeding work with animals and plants. As far back as the ancients, planters had their regular methods of seed selection, and some of their methods were superior to ours of today. Virgil wrote in his *Georgics*, which all of us should read some day:

“Still will the seeds, tho chosen with toilsome pains,
Degenerate, if man’s industrious hand
Cull not each year the largest and the best.
’Tis thus by destiny, all things decay
And retrograde, with motion unperceived.”

This is a principle as fresh to the present plant-breeder as it was to those in Virgil’s day, and as important as any law that has been uttered since his day. There have been few better horse breeders than the Arabians who developed long before the Christian era some of the best race horses the world has ever known.

Cross-Breeding.—We shall have before the class some flowers of the cotton, or of any convenient garden or ornamental plant, and study the sex organs for an understanding of crossing. Look carefully for the stamens and the pistils of the flowers. The stamens are the male organs and the pistils the female organs of the plant. To cross flowers, we must take all the stamens off the flower the day before it is ready to open, and cover with some kind of light paper or cloth bag, to keep insects from getting to it before we are ready to apply pollen to the stigma. When we are ready to introduce the pollen, take the bag off, and apply pollen to the sticky end of the stigma, rubbing lightly but thoroughly so the grains will stick to every part of the stigma, and then put the bag back over the flower and leave for at least twenty-four hours. If the fruit comes to maturity, you have succeeded in the cross. If it does not come to maturity, you have failed. The flower should be marked with some small

tag in order that it may be recognized and collected separately from the other part of the crop.

Crossing is not recommended for popular work except to show classes just how difficult the process is, and why the average farmer should not attempt it at all.

CHAPTER XXIX. TRUCK FARMING.

Truck farming should engage our attention as a necessary part of every farm. Most of us are in the habit of thinking of trucking as a supplementary income to the general farm. It is best in this capacity or as a special line of farming, but most people will not undertake trucking as a specialty. As a smaller business, we would urge every one who has a garden or a place for a garden



A LOAD OF TRUCK.

at all, to keep something growing in it all the year both to eat and to sell. This method of growing spring vegetables and then letting the garden spot grow up in weeds is inexcusable. Vegetables are most wholesome and far better than other kinds of food, and should be grown and eaten to a greater extent than at present. How delightful is a fresh lettuce head in mid-winter both for

decoration and for eating, and yet we could have this delicacy every day in the year if we planned for it. Lettuce will grow in the open in the Southern States all winter. Many other vegetables quite as nice for the winter table will grow in the open all winter in the South.

Market-gardening.—Trucking is sometimes called market-gardening. In fact, market-gardening may be said to be trucking on a smaller scale. In market-gardening the intense manuring and high culture of the kitchen garden is applied to larger areas. The produce is generally sold in a fresh condition in a nearby town or city. Rapid transportation and refrigerating methods have made it profitable to send these fresh vegetables to quite distant markets. The great cities of the North are thus supplied with the luxuries of the South early in the season. This has given quite a stimulus to truck-farming in the South.

Advantages of Location.—The tendency of salt air to keep off frosts, gives great advantage to the sea-coast regions. A few days' difference in reaching the market often makes a great difference in the price. Every method of hastening maturity is resorted to among truckers. Forcing beds, glass houses, cold frames, heat-producing manures, and early varieties of vegetables all have a bearing upon the success of the gardener. Nearness to market, rapidity of transportation, cost of carriage, and facilities for keeping vegetables from withering and decay-



MAKE THE GARDEN A LEADING FACTOR IN FARMING. :

11

ing, are other important points. The successful man must study all of these.

Use of Large Quantities of Fertilizers.—Market gardeners find it pays them to use very large quantities of manure and fertilizers. They generally depend largely upon the cities near them for manure. They sometimes find it pays to haul this long distances, if the roads are good. From the larger cities, this manure is shipped out in car or train loads. This is because land near these is not sufficient and gets to be too dear. The cost of carrying manure is less than the cost of the land. Very highly manured land is warmer and hastens the maturity of vegetables.

Quality Better than Quantity.—Another point of great importance to the truck-farmer is the quality of his vegetables. Sorry vegetables are hard to sell, and do not bring paying prices. Good vegetables are always in demand and generally at paying prices. The market is never oversupplied with strictly choice articles. Please the eye and the palate, and you will find ready sale and good profit. To treat of this subject in detail would fill a good-sized book. We can only touch it here generally.

Tillage an Important Item.—But no one thing is more important to the trucker than deep, thorough work. He must grow large crops on small areas to get a profit on his high-priced land and heavy manuring. More than this, he must grow several successive crops on the same area during the same season. To do this, he must have depth of soil, so as to

furnish plenty of root-bed and water. He must have fine soil, so that the tender roots may not be hindered in their growth. He must have it both deep and fine, so that he may have a full supply of soluble plant food always ready. The demand will be enormous, and the supply should be equal to every demand.

Work must be very rapid. The soil must not be allowed to bake or crust. The sunshine must find ready access, with plenty of air. This will have much to do with the quality as well as the quantity of the crops. No useless plants or harmful weeds should be permitted to divide food with the growing crop. Selecting a location is quite important, but rests upon different reasons now. Distance is not so important as it once was. Access to a railroad is about the only essential point in many cases. Of course, what you expect to sell is always a leading point. Costly and perishable vegetables would require quick access to market. Others, which are cheaper and not so perishable, may be profitable further on.

Practical Points about the Business.—Onions, Irish potatoes, cabbage, turnips, and such vegetables, can be grown almost anywhere. They will bear shipping and keep well. Lettuce, radishes, peas, beans, and the like, will not take such risks. Two things should be well considered by every one before going into the trucking business: Do you know how to grow good vegetables? Do you know how to sell vegetables? If you can answer yes to both of these, then you may safely take up truck-farming as a business. If you can

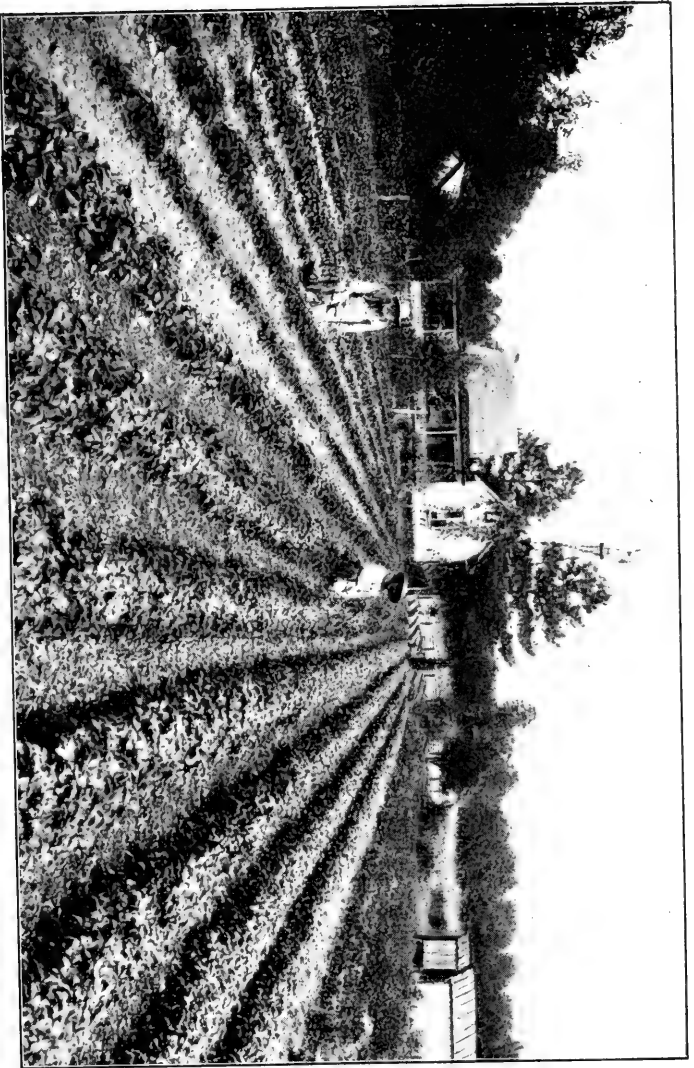
not, and still think you would like the business, then you had better work for a year or so with some one who makes a success in this line. There will be time gained by doing this.

Relation of Trucking to Population.—As the population increases, this line of work will in-



ONIONS SHOULD FORM A LARGER PART OF OUR DIET.

crease. Besides this, as we of the South learn to better appreciate our advantages, we will do more of this work. Rapid transportation and cold storage are making such wonderful improvements in carrying, handling and preserving vegetables and fruits that distance makes but little difference. Almost everything depends upon climate and intelligence. Even the most perishable article can be kept several days and delivered in



A STRAWBERRY FIELD—A MINE OF WEALTH.

perfect condition thousands of miles away. Skill and industry will give success almost anywhere in the South. The small fruits are generally considered as belonging to the trucker's business. We will speak of a few of these.

CHAPTER XXX.

SPECIAL CROPS.

Strawberries.—Strawberries find a ready sale everywhere. They contribute to health and make one of the most enjoyable dishes on the table of rich and poor. In many parts of the South they can be set out almost any time of the year. June and November are perhaps the best months. The rows three feet apart and the plants one foot apart, gives a good start. If you wish the largest berries, keep them in hills. If you want the greatest quantity of fruit, let them mat about one foot on the bed, but do not let them get too thick. Provide a new setting every third year. Some plants have only pistillate, or female, blooms. Not more than two rows in three should be set in these. Some varieties have both staminate and pistillate blooms. If you buy your plants, look to these points. They need only fair manuring. This should be put in before setting plants. If more is desired, put on as top dressing in winter. Keep out weeds and grass and supply plenty of moisture. Some practice mulching with very satisfactory results. They do not need to be covered in the winter and burned off in the spring, as the Northern writers advise. They are shallow-rooted plants, and lack of moisture is their greatest enemy. Plant early and late varieties, ship only the best berries, find a reliable dealer, and you will make money with strawberries.

Raspberries.—Raspberries grow well and sell well. A small plot of land will make a large quan-

tity. Many varieties are claiming to be best. The black caps are very good. Plants should be set four feet apart in five-foot rows and kept clean. The shoots grow one year and bear the next. The same canes never bear but one crop. So it is best to cut them out as soon as the young canes get a good start. The buds should be picked out when about three feet high. This will give them body so as to stand strong and branch out well. Proper attention to this point will largely increase the yield.

Blackberries and dewberries require much the same treatment and pay equally well. Because blackberries grow so very abundantly throughout the South, in all the fields and along the branches, they have not received that attention they deserve. We have not yet found out that culture could greatly improve them. It will be a long time before the market will be supplied with first-class berries.

Other Important Crops.—Currants, gooseberries, figs, and such fruits, belong here. Melons also add to the variety of the trucker's products. Recently the Georgia watermelon has made such a reputation that growing it has almost or quite reached the dignity of a separate industry. Growers plant the vines ten by ten or twelve feet apart. They use fertilizers with a high percentage of potash. The cultivation is simple and easy. Melons grow very rapidly. For shipping purposes the thick-rinds are preferred. They are not generally as well flavored as the thin-rind varieties. Many growers prefer

to sell in the fields or in car lots, loaded at their nearest station. There is nothing the trucker grows which surpasses in delicacy and flavor the cantaloupe. The genuine article, medium in size, thoroughly netted and tender-fleshed, always finds ready sale. Great care is required to keep seed pure. They mix easily with other muskmelons.

The soil should be well pulverized, not very rich, and lie to the morning sun. Beds should be thrown up lightly, six or eight feet wide. Plant one vine every four feet. Work rapidly. The worms are apt to destroy all late crops.

Tomatoes.—Since the organization of Girls' Canning Clubs throughout the Southern States, the growing of tomatoes is becoming not only a profitable business, but a most pleasant occupation, especially as home canneries are easily operated, and winter supplies stored at such a nominal cost. Besides, the girls of the family have found a great interest in growing the tomatoes and canning them for sale. In this way they find a rich source for getting ready money, and they should be encouraged in the work.

Tomatoes are not hard to grow. They are a very delicate plant, and must be started in the house in boxes about March 1st and reset in the field in April. They require rich soft soil and large applications of fertilizers, with high per cent of available nitrogen and potash. The tables in the back of this book contain formulas for truck crops.

It may be interesting to know that all varieties of this important food plant came from a single

plant found in the Andean district of South America.

Trucking a Paying Business.—Enormous yields are produced by truckers on small areas, and immense fortunes are sometimes realized. There is a small farm near Paris, which is reported as follows:

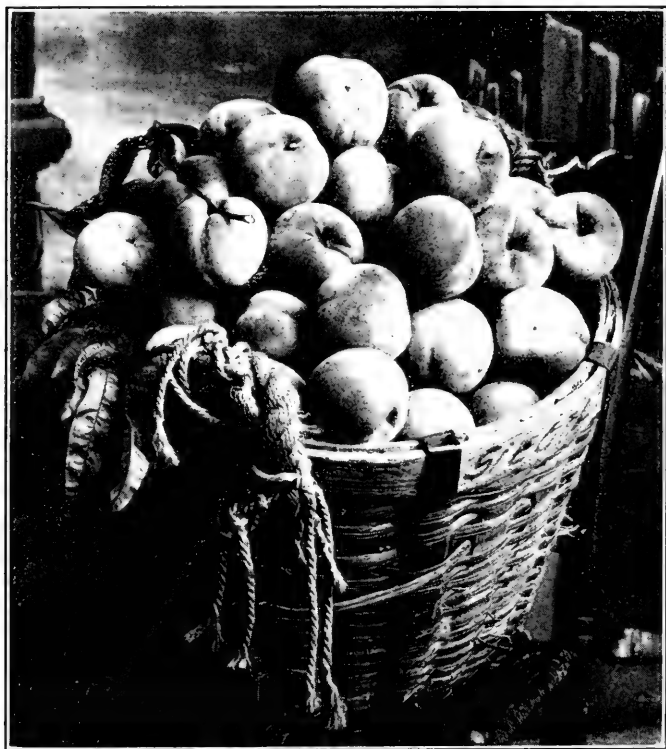
This farm contains two and a quarter acres.	
Rents annually for.....	\$ 500.00
Labor account.....	5,000.00
Interest on the capital.....	750.00
Account for horse power.....	500.00
Sundries.....	250.00
Manures.....	1,500.00
	<hr/>
Total amount expended.....	\$8,500.00
By proceeds of sales.....	13,640.00
	<hr/>
Annual profits.....	\$5,140.00

We find here two valuable lessons: the enormous productive power of the soil, and the fact that great profits may be made by skill and industry, growing successive crops on the same soil. Here we find men with nerve enough to invest eight thousand five hundred dollars in a two and a quarter acre farm, while many hesitate to risk fifty dollars per acre. They nearly doubled their investment. This is a very extreme case, but extreme cases are instructive. If this has been done, we may do partly as well.

He who grows what every one needs
Will find a market for food and seeds.

CHAPTER XXXI.
FRUIT CULTURE.

Fruit culture is a profitable line of farming; and even where it is not pursued on a commercial



THE GEORGIA PEACH.

scale, an orchard adds so much to the health and pleasure of life that no farm should be without one. It is the privilege of the teacher of Agricul-

ture to arouse the interest of his pupils in Horticulture, and to put them in the way to success in this pursuit.

Besides, no agricultural subject affords opportunity for more simple and interesting practical laboratory work, and the enterprising teacher will welcome the means of giving interest to his class work.

Class Work.—In the home orchard it should be the object to secure the largest variety of fruit for the longest period possible. If any fruit is grown in the section in which the school is located, the pupils should be encouraged to find out what sort of fruits have been most successful and to form some idea of what varieties of apples, peaches,



ANY FARMER CAN AFFORD A BARREL SPRAY PUMP.



A WELL PRUNED TREE.

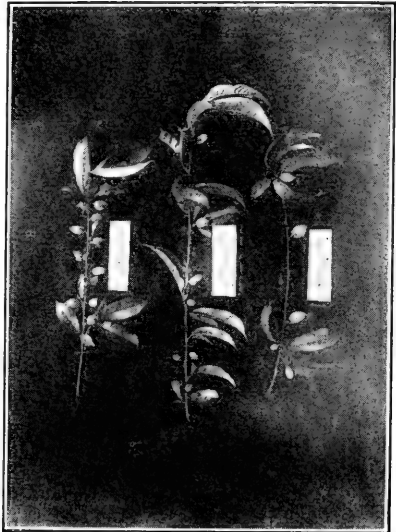
etc., are best adapted to their locality. This forms the basis of success with fruits, for it should be well known that little reliance is to be placed on the representations of agents and catalogues of various nurseries.

In addition, pupils should learn the importance of testing

new varieties of fruits that offer any promise of value.

Proper treatment of orchards should be outlined by calling attention to the most successful fruit growers of the section, and by indicating the best methods used by them and elsewhere.

Most interesting lessons may be given in the propagation of fruit trees by budding and grafting and by cuttings. The



PEACH TWIGS SHOWING UNTHINNED, POORLY THINNED AND WELL THINNED FRUIT.

following descriptions of these operations contain the most important matters in connection with them and will serve as a basis for laboratory work.

Budding.—Budding is one of the most economical methods of production of fruit trees. It is more certain to reproduce the qualities of the tree

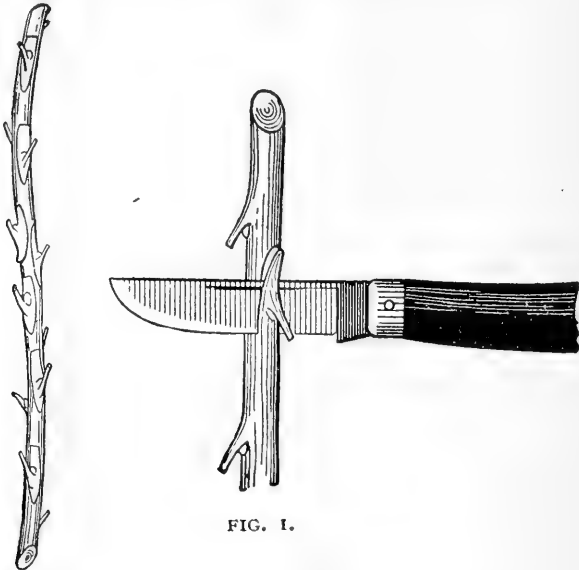


FIG. 1.

PREPARING BUDS.

to be propagated than the use of seed, and maturity can be hastened. It can be used in many varieties of fruit where cuttings are not successful and it requires less of the tree that is to be propagated than does grafting. It is at present the most common method of propagating fruit trees, and especially peaches.

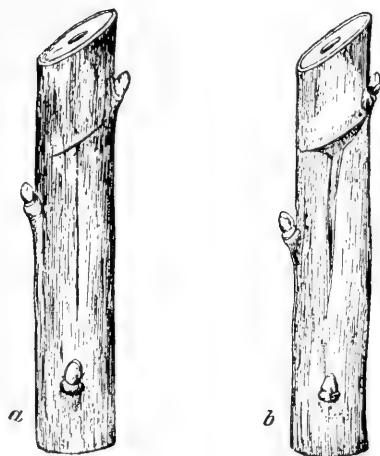


FIG. 2

PREPARATION OF STOCK TO RECEIVE BUDS.

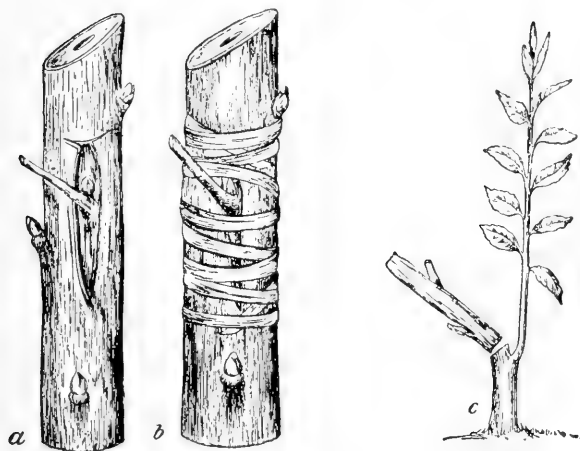


FIG. 3.

(a and b) BUDS INSERTED AND WRAPPED; (c) OLD STOCK REMOVED.

The season for budding is from June to September while the tree is growing and the bark will slip. The method is as follows: Cut from the tree that is to be propagated, a limb of the present season's growth, and remove the leaves, leaving part of the stem attached to the bud, as in figure 1. This is called a bud stick. Bud sticks should be kept carefully wrapped in the moist cloth until immediately before using. In the stalk or tree in which the bud is to be inserted, cut a T shaped incision as in *a* of figure 2. From the bud stick cut one of the buds as in figure 1. Pull back the corners of the bark of the stalk as in *b* of figure 2 and insert the bud as in *a* of figure 3, being careful to secure contact with the inner surface of the stalk which is exposed by lifting the bark. In cutting the bud it is customary to include a thin slice of the wood which may either be removed before inserting in the stalk or left with the bud.

The next step in the work is to wrap the inserted bud as in *b* of figure 3 with raffia or with wrapping cotton. This wrapping should be removed as soon as the union between bud and stalk is complete. If the budding is done before August 1st, it is called a June or summer bud, and the upper part of the stalk should be removed when the ligature is taken off, so as to throw the sap into the bud. If the operation takes place after August 1st, the bud is called a dormant bud and is not to grow until the following spring when the top of the stalk must be cut off.

Grafting.—For certain purposes grafting is more convenient than budding, though it requires more of the wood to be propagated.

The twig or shoot taken from the tree to be propagated is called the scion, and that into which it is grafted is called the stock. The scion should have three buds. It should be cut when the tree is dormant and stored away in damp moss or sand, in a cool place, till the beginning of the growing season, when it may be inserted in the stock. Roots for root grafting should be stored in the same way.

Two kinds of grafting more generally used, called whip grafting and cleft grafting, are here described.

Cleft grafting is especially adapted to use in large stocks above ground. The scion should be cut to a wedge shape with one side thicker than the other, leaving one bud near the upper part of the wedge. The stock should be cut with a saw so that the bark is not loosened at any point. It should then be split and the cleft opened so that the wedge of the scion may be inserted. Care must be taken that the growing part of the bark of the scion shall come in contact with the corresponding layer in the bark of the stock. The success of the graft depends on the contact of this inner juicy layer of bark. It remains to exclude the air which is done by the use of grafting wax either spread over the surface of the joint or incorporated in the cloth or cord which is wrapped about the union of the scion and stock. The process is illustrated by pictures showing stock and scion and the completed graft.

Whip grafting is adapted to use with smaller stocks and especially in root grafting. The

diameter of the scion and stock should be nearly the same. To make a whip graft, cut the stock off diagonally, one long smooth cut with a sharp knife, leaving about three-fourths of an inch of



CLEFT GRAFTING AND WHIP GRAFTS.

cut surface as shown in figure 1. About a quarter of an inch from the upper end of the cut surface split the stock vertically. Prepare the scion in the same way, cutting lower end. Then insert

the scion in stock and wrap as in figure 3, being careful that growing surfaces of the bark are in contact. If above ground exclude the air with wax as in cleft grafting.

Cuttings.—Many plants can be grown from cuttings—as figs, currants, grapes, etc.

Hard wood cuttings are made when the wood becomes dormant, and kept in a cool place in wet sand until the roots begin to grow and are put out in the spring. A cutting should have two buds, one to be put under the ground and one above. It is important in making cuttings to reduce the leafage to a minimum so as to prevent evaporation and wilting.

Soft wood cuttings are made of many flowers and house plants. Geraniums are frequently so propagated. A common use of this method is in planting sweet potatoes by cuttings of the vines. The mistake is frequently made of leaving too much vine and leaf. Two buds are sufficient and such a cutting will grow off with less wilting.

CHAPTER XXXII.

CROP PESTS.

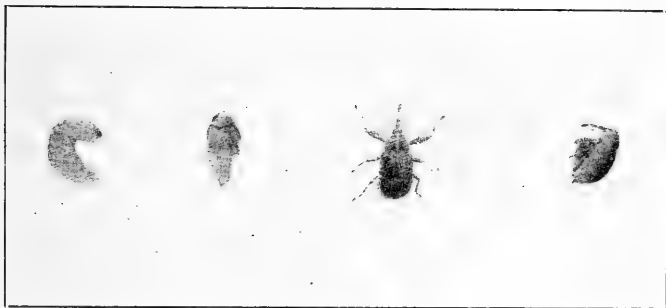
Crop pests are usually divided into two general classes: insect pests and fungous diseases. Of the two, insects are perhaps the more destructive to farm crops because we have not yet learned to protect birds and other enemies of insects. Insects are the most voracious of all animal life, some having been known to eat their own weight more than fifty times in a day of twenty-four hours. We shall first take up a study of the insects.

Insects Generally.—There are two classes of insects, biting insects and sucking insects, determined by the method by which they feed upon plant life. Biting insects, of course, bite and chew their food while sucking insects suck the juices from the plants. These two classes of insects must be dealt with in accordance with their methods of eating. For the biting insects we must use arsenic or some other poison, that will kill if the insect eats it, and for the sucking insects we must use some spray that will kill by coming in contact with the body. If we tried to apply something to the sucking insect to eat, the poison would have to go through the tree and be sucked out through the juices of same. This would, of course, kill the tree, and we might as well let the insect kill the tree and save the cost of the poison. Biting insects are for the most part invested with such a heavy covering that it would take a very strong spray to kill them, in fact so strong that the tree or plant would be injured, if not killed. There-

fore it has been found best to apply poisons to the foliage or other parts of the plants and let this class of insects commit suicide—so to speak—by eating this poison.

Biting Insects.—Under this heading we are to learn about several of the more common injurious insects and the best methods of controlling them.

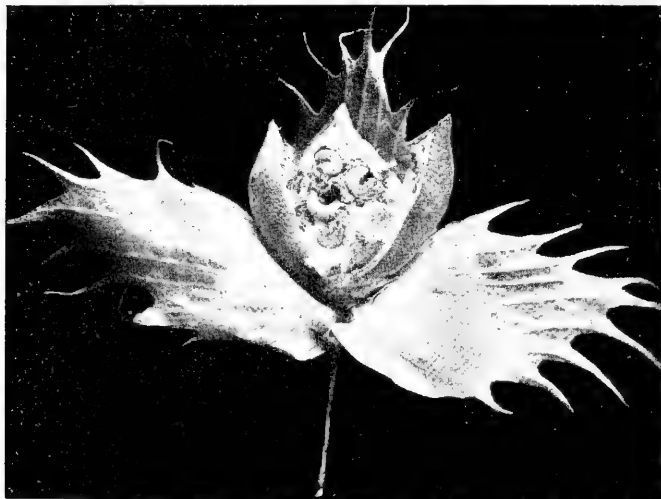
(a) *The Cotton Boll Weevil.*—No insect has been so prominently before the public in late



MEXICAN BOLL WEEVIL; LARVA, PUPA AND ADULTS.
(Year Book, U. S. Department Agriculture, 1903.)

years as the Mexican cotton boll weevil. In fact, all the newspapers give space to this unwelcome visitor in which they could make thousands of dollars otherwise with advertising matter. But why do they give him so much space? By so doing they save the readers of the paper millions instead of thousands of dollars, for the reason that readers may see the papers and learn how to control the weevil. This is one biting insect that it does not pay to spray for control. His control

will depend entirely on crop rotation, burning of old plants in which he may winter, and fall plowing, and the planting of an early maturing cotton. There has been no other successful method yet found.



BOLL WEEVILS DESTROYING COTTON BOLL.
(Year Book U. S. Department Agriculture, 1903.)

(b) *Curculio* or *Peach Weevil*.—This is a very common weevil of the orchard and usually bites the peach or plum, lays the egg, which hatches into what we call a worm, or, in fact, a larva, and we have wormy peaches and plums. The remedy for this pest is arsenate of lead 2 pounds to 50 gallons of water when shucks fall from the flowers. Second application, about three weeks after first. Paris green may be used.

(c) *Grain Weevils*.—These little pests destroy many thousands of dollars' worth of grain in the course of a year and should be destroyed themselves, so easy are they to control. They are almost everywhere and are black or brownish-red in color, quite slender, and resemble somewhat the corn bill-bugs. They can be easily controlled either by sprinkling the grain with bisulphide of carbon, or by evaporating the carbon bisulphide one ounce to fifty cubic feet of air space. This is very inflammable and no fire of any kind should be brought about it. One should not even smoke about the bin in which the grain is stored for some time after the application. It might pay to suggest that this remedy is more effective when a special air tight bin is constructed to store the grain while being treated.

(d) *The Codling Moth or Apple Moth*.—This is a small dark colored moth that appears about the time the apple trees are in full bloom. The moth lays a single egg on the fruit at the point where the flower drops off and, when this larva comes from the egg, it feeds on the apple until grown, and when mature, eats its way out, goes to some suitable place and spins a cocoon. In this it remains till the next spring, when it begins its evil work again.

The treatment for this moth is arsenate of lead or Paris green. If Paris green is used, mix slaked lime with it in the proportion of about 10 to 15 parts of lime to one part of Paris green and make light applications three times in as

many weeks and you will have very little or no trouble with this pest.

(e) *Twig Girdler*.—This is a common insect about the nut groves, and the hickory and oak trees and is very destructive to these trees. He trims them a little too close and in the wrong season. He bites around the branches and cuts them off almost as smooth as one could do it with a pocket knife, and then goes out on the branch he has thus destroyed and lays many eggs to be hatched while the wood is souring. These eggs remain till hatched and the larvae are full grown by the next summer.

Treatment of this pest.—If young trees are severely attacked, the beetles should be hunted out and destroyed, but on the older trees, the branches should be collected and burned. The trees should be sprayed twice with arsenate of



MOTHS AND PUPA OF PEACH TREE BORER
—NATURAL SIZE.

lead. These suggestions will if carried out control the girdler.

(f) *Potato Bug*: A very common pest to all who have ever tried to grow Irish potatoes. To describe this insect here would be throwing away space, so we go on to the remedy. Apply Paris green mixed with flour or water, the flour being preferable, in the proportion of twenty pounds flour to one pound Paris green. This is a sure remedy if applied in time and will not injure the potatoes if properly applied. It should be applied early in the morning before the dew has dried off from the plants, so the Paris green will stick. If the beetles come out again, the same remedy should be applied a second time.

(h) *Cabbage Worm*.—This worm will be recognized by all who have cabbage, as a familiar white cabbage butterfly or a striped worm that goes into the cabbage and eats it away.

Arsenical poisons can be used to advantage and Paris green is very effective, only do not apply these poisons for three weeks before using the vegetables for the table. Sometimes poison bran mash used as for cut worms is very effective and can be applied with perfect safety.

(g) *Cut Worms*.—Everybody knows the cut worms, but it is suggested that a school should have a collection of all insects that can be found in the locality of the school including the cut worms. This is a good idea, and should be carried out.

The effective way to get ahead of the cut worms is to put a small paper collar around the

trunk of every small plant. This is a sure remedy and can be done at a very small cost. The paper will last almost the entire season, and very few have to be replaced. Bran mash dropped around the young plants is also effective. This poison is composed of:

- Bran, 25 pounds.
- Paris green, $\frac{1}{2}$ pound.
- Cheap molasses, 1 quart.
- Water as needed to moisten.

For smaller amounts of poison use correspondingly smaller quantities of the ingredients.

Sucking Insects.—This class of insects must be treated differently from those mentioned above,

GIPSY MOTH. *Porthetria dispar* L.

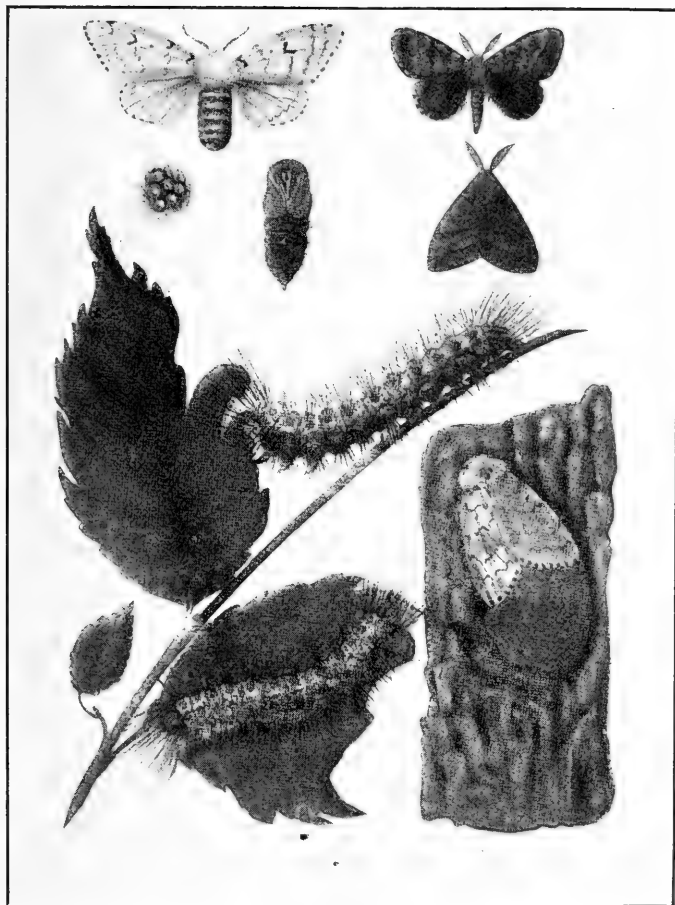
ORIGINATION AND SPREAD.—The Gipsy Moth has been a serious pest in Europe, at intervals, since the first authentic report in 1662. Records show that large areas often embracing thousands of square miles of forest trees have been entirely stripped of their leaves. Gipsy Moths were first brought into this country in 1868. About 1890 they had become such a serious pest throughout the eastern part of Massachusetts, some twenty towns having become infested, that the authorities commenced the task of extermination. Previous to 1900 a million and a quarter dollars had been spent with the result that so few moths could be found that the Legislature stopped the work of control. By 1905 the moth had increased to such an extent that appropriations were made to commence again the work of suppression. The insect had spread into Rhode Island, Maine, Connecticut and New Hampshire. It has not yet, however, become established outside of the New England States. The spread of the Gipsy Moth is comparatively slow because the female does not fly far.

PLANTS PREFERRED AND EXTENT OF INJURY.—The laws and appropriations for suppressing Gipsy Moths have generally applied also to the suppression of Brown-Tail Moths. The following figures show private expenditures and public appropriations for combating both insects. *These figures do not include any estimate of damage caused by the depredations of Gipsy and Brown-Tail Moths.*

MASSACHUSETTS: Amount expended by the Commonwealth of Massachusetts from 1890 to 1899 and appropriated from 1905 to 1910, \$2,770,000 00	
Amount expended by cities, towns, individuals, etc., in Massachusetts from 1900 to 1904, when there were no state appropriations.	3,136,090 00
UNITED STATES GOVERNMENT: Appropriations, 1906 to 1910,	1,082,500 00
MAINE: Appropriations, 1905 to 1910.	120,000 00
NEW YORK: Appropriation, 1910.	50,000 00
NEW HAMPSHIRE: Appropriations, 1907 to 1910.	50,000 00
RHODE ISLAND: Appropriations, 1906 to 1910.	41,100 00
CONNECTICUT: Appropriations, 1906 to 1910.	20,800 00
Total.	\$7,270,490 00

REMEDIES.—Paint egg clusters with creosote in fall, winter or spring. Spraying in June with arsenate of lead is an efficient treatment. Band trees with burlap and examine daily.

(Copied from New York State Department of Agriculture.)



GIPSY MOTH.

SEE DESCRIPTION AND REMEDIES ON PAGE 190.

as they feed so differently. The remedy must come in contact with the body of the insect and be of such nature as to kill when it so touches him.

(a) *San Jose Scale*.—This is the most common of all the sucking insects, and can be recognized as a small gray scale-like insect sticking close to the trees on which it is commonly found; it is common on fruit trees, shade trees and ornamental plants, and will kill any of them if left to do its work. The universal remedy for the scale is the lime-sulphur wash, which is made as follows:

15 pounds lime,
15 pounds sulphur,
50 gallons water.

This must be thoroughly boiled. To use it then it must be reduced in the proportion of one gallon of the concentrate to eight or ten gallons of water.

(b) *Plant Lice*.—Lice will be generally recognized and a description will not be attempted. They frequent the tender young shoots of apples, grapes, roses, etc. The treatment is as follows:

1 pound whale oil soap,
8 gallons water,

thoroughly mixed, [or]

1 pound tobacco,
1 gallon water,

mixed and stood for an hour.

Kerosene may be used but is not best. If used, it should be emulsified as follows:

Half pound hard soap,
1 gallon soft water,
1 quart kerosene.

Churn for 20 minutes and mix thoroughly; add

two and a half gallons water, and you will have 7% emulsion.

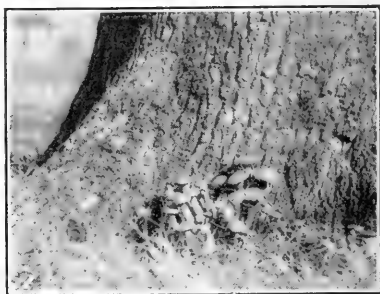
(c) *Harlequin Cabbage Bug*.—This is a flat looking small bug marked with conspicuous yellow or red. The leaves attacked shrivel up and turn brown. This bug is often known as the calico or terrapin bug. The eggs are very peculiarly marked black and white eggs and in patches on the leaves of the plants attacked.

The remedy is to clean up the garden in the fall and plant trap crops in spring and summer. There is no application of poisons that has proven sufficient. Kale or mustard are good trap crops, and when they become loaded should be collected and burned. Kerosene may be poured over trap crop.

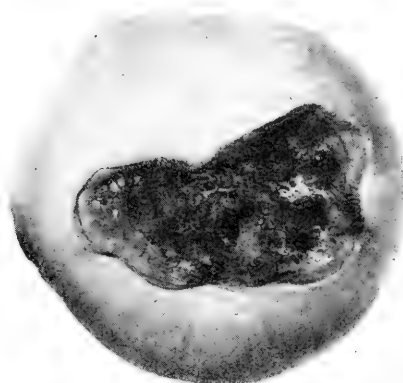
Fungi.—This is about as much as need be said about the common insects of the farm. In addition to the insect enemies of farm crops we have many fungi that destroy millions of dollars' worth of farm crops. There is only one general remedy to get rid of or reduce fungi, and that is to rotate crops when the fungus appears. We must bear in mind that the fungus is left in the field even when the crop is taken off, and needs only another growing crop of the same kind in order to thrive again in spring. It is important therefore that we dodge the fungus if we would reduce it to a minimum.

Self boiled lime and sulphur is the best universal remedy as an application to growing fungi. It does not injure the trees very much and will kill the fungus if carefully applied. It is strictly

a summer remedy and is never used in winter. To make it, place twenty pounds of lump lime in a barrel and pour three gallons of cold water over it. After the slaking is thoroughly under way add twenty pounds flower of sulphur free from lumps. The heat thus generated will bring about the proper combination between these two ingredients. Add more water till



FUNGI TAKING THE LIFE OF A FINE OAK.



FUNGOUS GROWTH ON TOMATO—A COSTLY DISEASE.

Add more cold water in about fifteen minutes as soon as the boiling is over. To this must be added water till the total quantity is brought up to about one hundred gallons. Never put *hot water* in this mixture.

This may be applied to brown rot of apples, and peaches, and any other fungous disease that should appear in the orchard, garden or field.

CHAPTER XXXIII. FARM ANIMALS.



Man Dependent on Farm Animals.—At one time in the history of the world man perhaps was not completely dependent on farm animals; but under our present organization of society he is dependent on animals in a large measure

(1) for food, clothing, and other products, (2) for services as beasts of burden, (3) to help maintain the fertility of the soil, (4) to help man to keep himself busy during winter. Many other uses may be mentioned, among which may be considered that of serving as man's companions. Our animal friends deserve a prominent place in our estimation and must have this in order to become of greatest use to us.

Classes of Farm Animals.—While no attempt will be given to go into detail in this short chapter, it might be well for us to consider the animals to which we owe so much for our welfare. Among these are especially the horse, the cow, the sheep, the hog, the goat, the mule, and smaller animals such as the barnyard fowl, the dog, and the cat.

The Animal in Relation to Soil Building.—

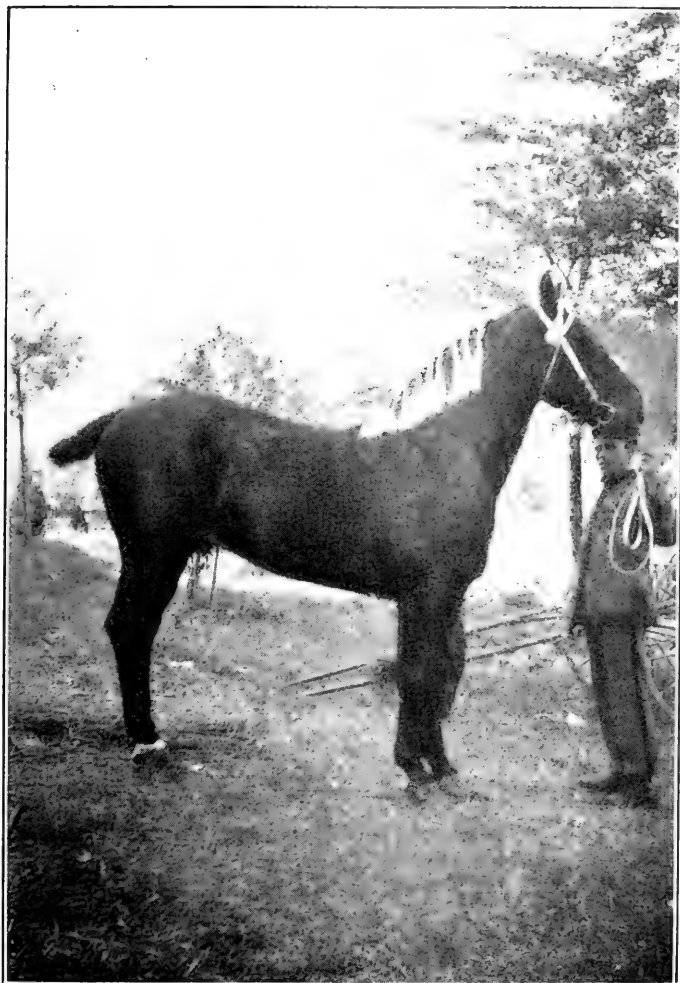
There is no better soil builder than animal manures; and therefore if animals are properly cared for and the manures carefully saved, this can be made a source of considerable income. In pasturing



THE MOTIVE POWER OF THE FARM.

stock, practically all the manures are left to enrich the pasture soil. No country thrives like the live stock country because of these facts. It is easier to keep the soil fertile and to raise large crops.

The Relation of Farm Animals to Crops.—
In the South where cotton has been the only crop,



THE BEST HORSE IS THE BEST INVESTMENT.

we need live stock to help initiate a system of diversified agriculture. Crops can often be raised and fed to live stock and in this way be made to yield larger profits than any one-crop system. It is said that the man who would prosper must not sell all the crops he grows, but must keep and feed a large portion of them.

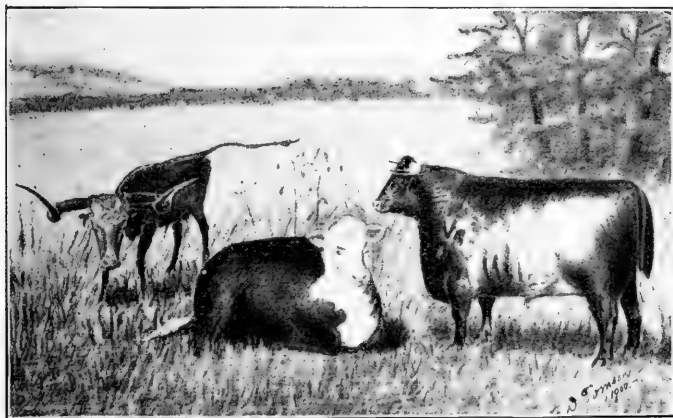
Feeding Animals.—In planning a year's crops, provision must be made for all the stock on the farm. Many times animals are not capable of good service because they are so poorly fed. A farm that grows plenty of food for the animals that are kept on it will always be found a success. It is only the lack of this that makes many a farm poor. We must work out just what our animals need and then try to supply these needs. In fact, we must not only *try* to supply them, but we *must* supply them, if we keep the stock.

Feeding the Horse.—A good rule to go by in feeding the horse is first to know what he weighs and then feed to him each day about one pound of concentrates, such as corn and grain, and one pound of hay to each hundred pounds of live weight. In hard working season, a twelve hundred pound horse should have about sixteen pounds per day of each kind of food, and the quantity can be lessened when there is no work to be done. It takes less to keep up a fat horse than a poor one.

Care of the Horse.—Whether the horse is to be plowed or kept for driving, he should be regularly groomed. It adds to his health and feeling, and we get so much good from him that we cer-

tainly should try to make life as easy as possible for him. We too often forget that the horse is dependent on us for his very life, and would die in a short while if we did not look after him. We also forget that the horse does perhaps more than the man in the production of the crop. He should therefore be entitled to the benefits of the crop, and should not be starved when the corn runs low. Next year we should provide better for him.

Improvement of Live Stock.—A great improvement can be made in our farm animals, if we will carefully mate and select them. This is easily done, inasmuch as they breed only at our will. Who does not recognize the superiority of the modern Poland China or Berkshire or Duroc Jersey hog over the old-time razor back? Yet all this has been brought about by careful breeding. This improvement can be carried on indefinitely



EVOLUTION OF THE KANSAS STEER.

if we will study our animals and select and breed for the best and most desirable qualities.

A Good Way to Improve the Stock of Cows.—

Where a farmer has a good many native cows and does not wish to sell them and start over, he may with great profit invest in a good bull to keep with his herd. This will be the starting point for an improved herd. When a farmer once sees how



A HEREFORD SIRE.

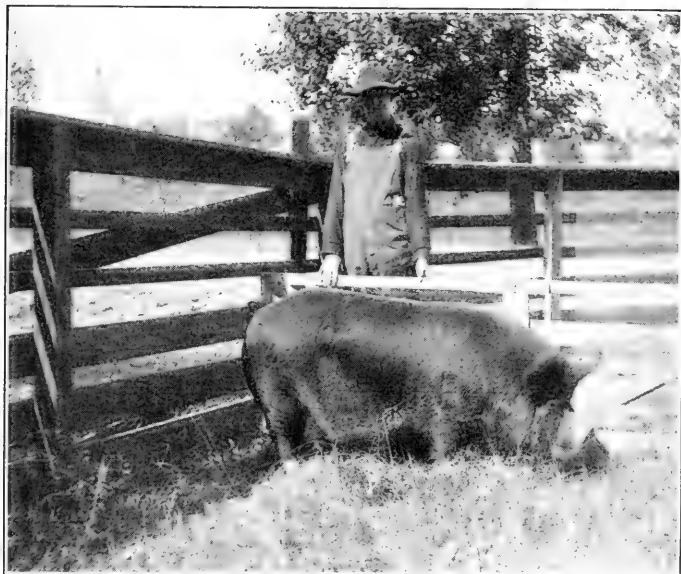
much improvement can be brought about in one generation, he will think differently of his herd.

The same method will work with his hogs. He will be able to make great improvements in one generation with his hogs by introducing a good boar into the herd.

Cattle.—The different breeds of cattle are

given in another chapter, but it is well to state here that every farmer should have a few of the best beef cattle to tread his pasture and afford meat and some sales as well. A beef herd will grow very rapidly and soon be a source of income, if cared for. The most practical beef cattle for the South are perhaps the Herefords, as they are of quick growth and are excellent for food purposes.

Hogs.—Hogs may be divided into two general classes, the bacon hogs and lard hogs. Or they may be classed again into the three heads: small breeds, medium breeds, and large breeds. Of the



SOUTHERN BRED BERKSHIRE—KNOWN AS THE "MORTGAGE LIFTER."

small breeds may be mentioned the Victoria, the Small Yorkshire, and the Essex; the medium, Berkshire, Poland China, and Duroc Jersey, and the large, the Tamworth, the Large Yorkshire and the Chester White.

The best hog for middling meat is the Tamworth, while the best perhaps for lard is the Duroc Jersey or the Berkshire. Of course, every breeder



HOME GROWN LAMBS BEAT THE MARKET MEAT.

has his choice in the matter of breeds and no two will agree on all of these. Hogs should be carefully fed and regularly looked after, if we would get the best results.

Sheep.—Sheep demand special attention and

unless we make up our mind to give them this attention we need not invest in them. They are easily kept and pay big dividends when properly looked after, but should be most carefully guarded and protected from dogs and the lambs kept from buzzards and owls. Several years ago there were a great many flocks of sheep in the southern part of Georgia, but there are very few found there now. This is due to the fact that the country is becoming more thickly settled and sheep have very poor ranges at the present time.

Health of Domestic Animals.—It must be remembered that animals as well as men get sick now and then and should be cared for. Their sickness is usually the result of our carelessness, and we often leave them to die without so much as knowing that they were sick at all. When we have to work them harder than usual, we should give them more care than usual. Sometimes it is only the money investment we consider in the case of sickness among our horses or other domestic animals. This should not be the case. It should be our duty to love and care for our animals just as, or almost as, we do for ourselves. Then we do not mind calling on the horse for the service we deserve from him.

Animal Husbandry.—Animal husbandry is almost unknown among our farming class, and yet would mean so much to our farmers if they could awake to the importance and value of the subject. This great subject treats of the raising and proper care of farm animals, a subject about which we know so little. When we come to consider how

large a portion of our farm products is converted into animal products before we can use them, the subject makes an appeal to us. In fact, we have greater opportunities on the farm the moment we make the live stock a part of our business. We then begin to grow in wealth and prosperity, and I think in happiness.

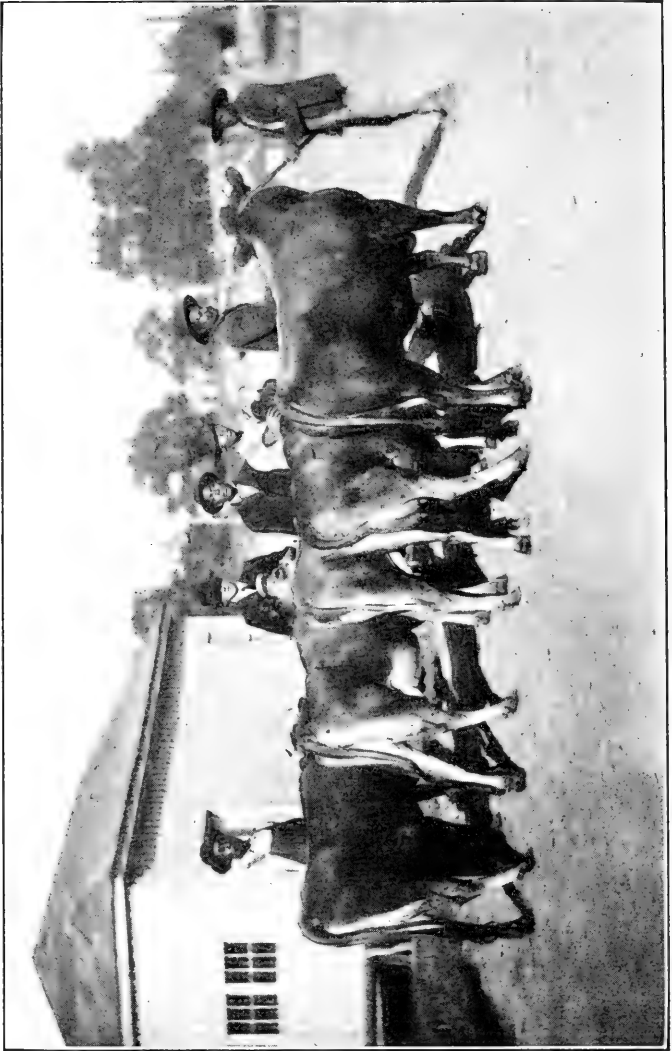
CHAPTER XXXIV.

DAIRY HUSBANDRY FOR THE FARM.

Need of Good Farm Dairies.—For a study of this subject, the higher classes should get blanks and fill them in with reference to the conditions that exist on the farms in the locality of the school. The number of cows in milking, the total number of gallons of milk gotten from the entire herd and the quality of the milk should be known. Milk is one of the very best diets, and certainly should not be denied growing children if we would keep good health on the farm. Children that use milk constantly in the diet usually grow faster, learn faster, think clearer and in every way are superior to those that are deprived of milk, other things being equal. It is imperative therefore that we have good sanitary dairies on all our farms, in order that we continue to supply from the country fine fresh blood with which to develop our great cities.

What is Milk?—We ask this question here, but leave the answer for pupils to find in any book, cyclopaedia, or dictionary they wish to consult. Only they must find a good definition.

The Source and Formation of Milk.—Milk is formed as we all know in the udder or mammary glands. It is claimed by authorities that milk is formed as it is drawn from the udder and is not collected in the udder as we are in the habit of thinking. We sometimes say that the cow's udder is full of milk. This is not literally true according to the best writers on the subject.



A HERD OF JERSEYS, THE MILK AND BUTTER BREED OF THE SOUTH.

What is it that does fill the udder in this way? It is perhaps a heavy flow of blood, which has to be filtered only to become milk. The milk glands filter this blood, when it comes from the teats in the form of white milk. The blood is one of the most vital forces in the body, and therefore during milking season, the cow should have the best of attention and care, if we would get the



A FARM BARN.

a—The barn with which he started.
b—Shows how dairy farming pays.

best results. It may be said that to milk her is to take a great deal of her life blood in order to keep up the more easily our own life blood. It would not be just nor wise to take this blood from her and at the same time return for it unkind treatment. In fact we get less milk the less gently we deal with the cow.

Beef and Dairy Breeds of Cattle.—Beef breeds of cattle differ from dairy breeds in that they must have trim bodies with heavy quarters and stomachs not greatly enlarged. The fat must go into the choice parts for food instead of into the stomach and into milk. The beef breeds are, Aberdeen-Angus, Herefords, Sussex, West Highland, Galloway, Devon, Red Polled, Shorthorns, and Polled Durhams. The milk breeds or dairy breeds are Jersey, Brown Swiss, Guernsey, Ayrshire, Kerry, Holstein-Friesian, and Dutch Belted. When possible it would pay to visit a dairy in order to see all the breeds mentioned above. One thing we can do is to describe all of them from our various readings and references.

The most popular beef breeds in the South are Herefords, Devons, and Shorthorns, and the most popular dairy breeds, the Jersey, Holstein-Friesian and Guernsey. The average farmer needs a dual purpose cow, one that gives lots of milk, but may be bred for beef too.

Feeding the Dairy Cow.—There is no more important item than that of feeding the dairy cow, if we would get a regular supply of milk of high quality. The nature and quantity of food determine the nature and quantity of milk, and to give this food at regular feeding times, and to milk the cows at regular times are almost as necessary as anything else. A cow is a very delicate animal and responds to good treatment quite as much as a human being does.

A good ratio of foods for a Jersey cow of medium weight per day is:

Cotton seed meal, 4 pounds,
Shorts or corn meal, 2 pounds,
Bran, 2 pounds,
Silage, 30 pounds.

This should be divided into two equal parts and fed to the cow twelve hours apart and about



MAKING HAY—THE COW'S BEST FEED.

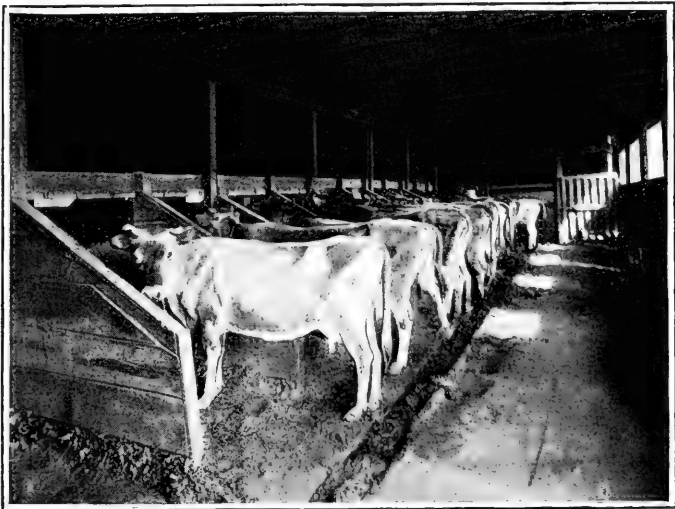
the time she is to be milked. When stover is given to a cow, she will eat about 6 to 10 pounds per day, if not too highly fed on other things. To feed other concentrated foods we should get their values in comparison with the above, and feed accordingly. It is to be hoped that cotton seed meal and clover hays will be fed far more generally to cattle in the South than heretofore.

The above food should cause a cow to produce two and a half gallons of milk per day, and if she does not, it is likely to be the fault of the owner unless the cow is a poor cow.

Fat in Milk.—We usually know the fat in milk as butter, or cream out of which the butter is made. This fat exists in milk in the form of small globules or round globes that can be seen and counted by the aid of the microscope. They constitute about $3\frac{1}{2}\%$ to $4\frac{1}{2}\%$ of the total weight of the milk, the exact per cent being determined by the richness of the milk. A cow should not be kept for milking purposes unless she gives milk with at least $3\frac{1}{2}\%$ fat.

Bacteria in Milk.—It is well for us to remember that bacteria exist almost everywhere, in the air, in the soil, and in water, and we must exercise every possible precaution in order to keep them out of any medium in which they are in the habit of growing. Milk is the very best food known for bacteria, and they develop faster in it than in any other kind of medium. One universal rule therefore is to keep all the milk vessels absolutely clean. We cannot afford to do less than this, and to do so they must be scalded out every time they are used, and left in the sun to air as much as possible. It is safe to estimate according to the best authorities that one ounce of milk will contain if left open a short while under normal conditions, over 2,000,000 bacteria, and these will multiply very rapidly if not checked by heating the milk, or disinfecting it. We may also affirm that 5% of all samples of town milk contain tubercular

bacilli, and that one calf out of every four is born tuberculous. All kinds of contagious diseases such as scarlet fever, typhoid fever, measles, smallpox, diphtheria, and many others thrive in milk and are thus transferred from one person to another. There are many thousand people who



INTERIOR OF A DAIRY BARN.

die every year on account of careless methods with the home supply of milk.

Why Milk Sours.—Not all the bacteria in milk are harmful bacteria. Many of them are indispensable to the natural processes of dairying. The lactic acid bacteria take possession of the milk immediately after it is stored away, in fact, as it comes from the udder, and soon produce lactic

acid in it. This they do by decomposing the milk sugar that is in fresh milk, to the extent of about $4\frac{1}{2}\%$ of the entire weight of the milk. At least a hundred kinds of lactic bacteria have been identified in milk, and therefore we must not look upon them as being one particular kind of germ.

Blue Milk and Ropy Milk.—We merely suggest here that nothing is wrong with the cow when we see blue milk, yellow milk, red milk or ropy milk. It is only a lack of proper care with the milk and the vessels in which it is kept. A particular kind of bacterium is associated with each one of these reactions, and precautions must be taken to keep this specific organism out of the milk if we would restore it to its former wholesomeness.

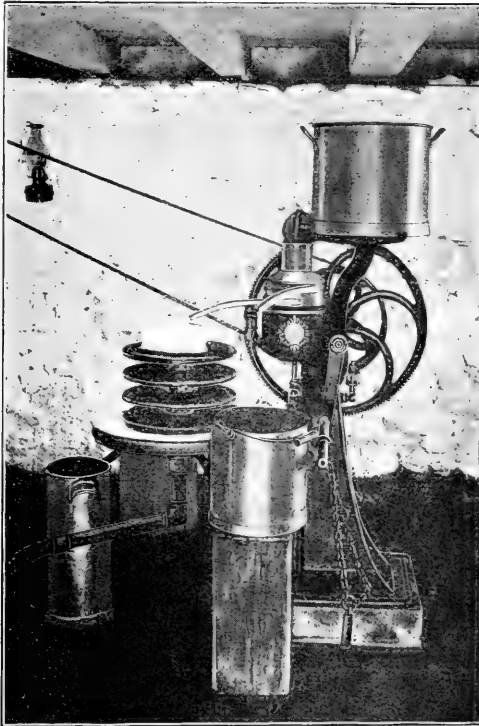
Bacteria in Butter.—It is safe to say that the sweet flavor and aroma of butter is traceable directly to the bacteria existing in it. The cream ripens only when these bacteria cause certain forms of fermentation to set in. It is said that one gramme of butter contains twenty millions of bacteria, a number so large that we cannot even think of it except relatively. If the butter has been exposed to disease bacteria, it will soon become thoroughly infested and will cause disease and death. Many cases of sickness and deaths have been traced directly to butter. Clean butter is most wholesome, but filthy butter is not only unwholesome, but very dangerous.

Sampling Milk.—It will not be a great while before we can have samples of milk examined at our Experiment Stations free of charge by an expert kept there for that purpose. This should

FOR HALLOWEEN, THANKSGIVING AND CHRISTMAS—AND EVERY DAY BETWEEN



be the case now. Every farmer should know just what kind of milk he is using on his table and should be advised as often as necessary of its quality and cleanliness. We should also know



A CREAM SEPARATOR—A TRIUMPH OF SCIENCE.

the exact food value of the milk of our herds, and when this is not up to the standard we should change the food of the cow or have her sent to the butcher for beef. This is what frequent examination of

milk would do for us. It would keep us safe from impure milk, and give us an interest in the subject and help us to remember to keep our vessels cleaner and milk purer.

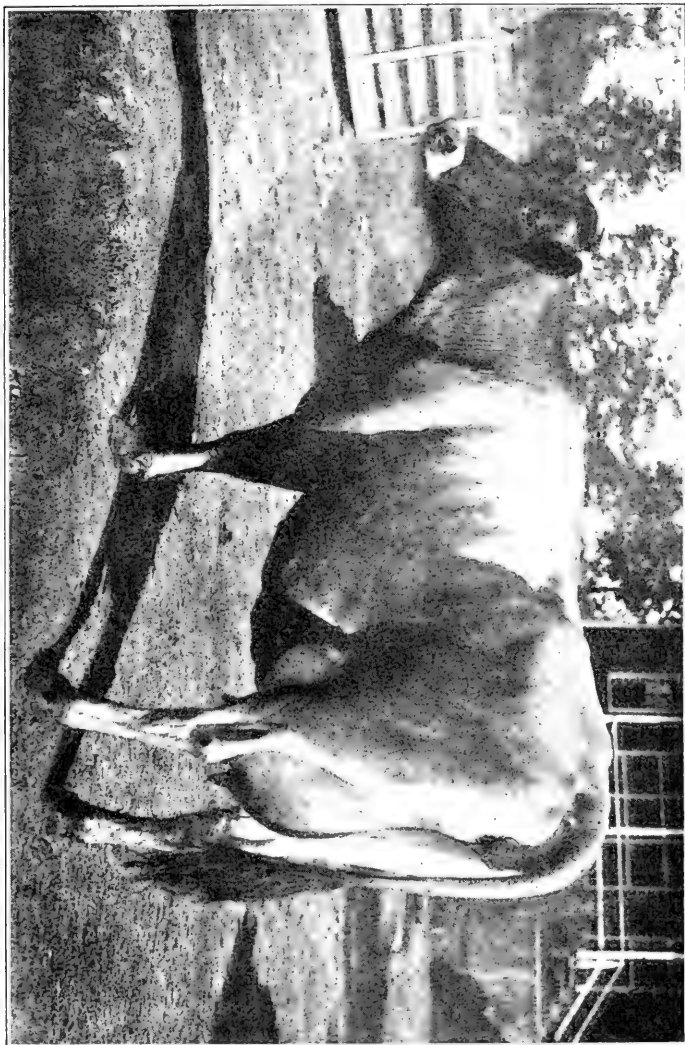
Milk as Food.—It is hardly necessary to say that milk is most excellent food. It is perhaps the best food we have, and the nearest a complete food. The three classes of food so essential are albuminoids, fats, and carbohydrates, or sugars. Milk has a large per cent of all these. The albuminoids are found in the casein, the fats in the butter and cream, and the carbohydrates or sugars in the milk sugar.

Milk is not hard to digest, if taken slowly and in proper quantities. It may be used in all kinds of cooking with good effect, and without injuring it as food.

Products of Milk.—All forms of cheese are made from milk; the cheddar, the Edam, Stilton, Roquefort, Camembert, Brie, and a dozen others. Most of them are made somewhat after the same general manner. The whey is allowed to drain out, and the curd thus formed becomes the basis of the cheese manufacture.

Skimmed milk, butter milk and whey are used to great advantage both on the table and to feed to animals. They all contain food value and should be considered in estimating the value of the dairy to the home.

Dried casein has been used in certain manufacturing processes to advantage. It is used as sizing for paper. This is made from the curd by treating it with certain acids and then letting it



A THOROUGHBRED JERSEY COW—A DAIRY TYPE.

dry. It is then stored in vessels and sold for sizing.

Milk sugar is made almost directly from the whey and is therefore not very costly. This material is the basis for many of the infant foods so popular in our homes. It was once used only for medicinal purposes, but its merit became so evident on further examination that it has become very popular as a food.

CHAPTER XXXV.

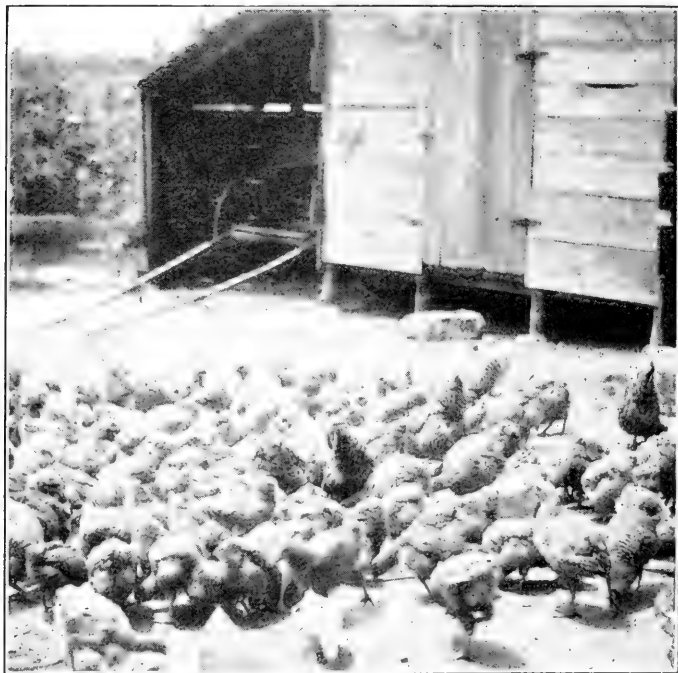
POULTRY FOR THE FARM.

It seems rather strange that farmers will work hard all the year and eat "hog and hominy" and then have to buy much of the chickens they eat if they eat any, when poultry can be raised so easily. If we once begin to think about it, chicken is not only better to eat, but in fact cheaper than most other meats, especially if we have to buy the other meats. One of the most pleasant things one can do on the farm is to have varied interests, so if one thing falls partly through, others will help to save us. The matter of raising poultry has been looked upon as child's play long enough. We should awake and really go into this as a real farm business. It will pay and prove exceedingly pleasant. Only a few suggestions will be given on this subject. It is a special business, but a small poultry business should be run in connection with every farm, if for no other reason, to get the boys and girls interested in such work and show them another side of farm life.

Types of Chickens.—There are several breeds of chickens and each breed has been produced in response to a certain demand. While this is not literally true, it is in general true. There is the egg bird, the meat bird, the dual purpose bird, and the fancy breed.

(a) *The Egg Bird.*—The most common of the egg birds we have in the South are the Leghorns, the Anconas, and the Minorcas. The Leghorns

themselves may be divided into the white, black, brown, buff, rose-comb, and others. This class of chickens has been bred solely for laying purposes; and while they are non-sitters, they pay if kept for the purpose for which they have been bred.

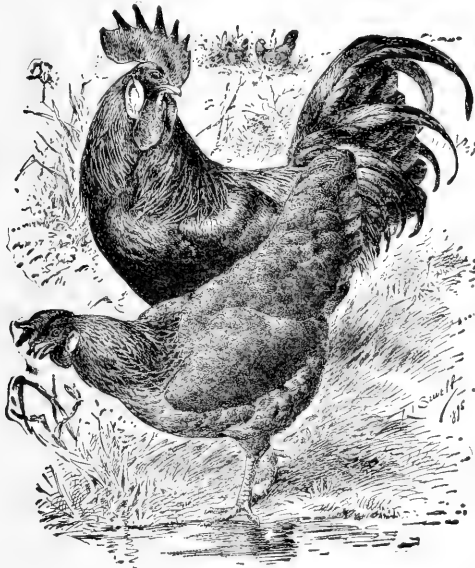


BEST AND CHEAPEST MEAT FOR EVERY FARMER.

Careful attention should be given to their diet and care, especially in winter.

(b) *The Meat Bird*.—To this class belong the Cochins, Brahmas, and Langshans. These three

breeds are of Asiatic origin and are large, heavy, awkward birds. They grow rapidly and make fine table birds, but may not be quite as palatable as other breeds. The Light Brahma is the largest chicken known, the cock weighing about 12 pounds and the hen about 10 or a little less.



BROWN LEGHORNS FOR EGGS.

(c) *The Dual Purpose Bird.*

—To this class belong the Wyandottes, Barred and other Plymouth Rocks, Rhode Island Reds, and Orpingtons. As the name suggests, these birds are good for laying and the table, and should be the most popular for the average farmer. They will lay and hatch the

eggs if required to do so.

(d) *Fancy Birds.*—There are a great many breeds of chickens that are not grown for any other purpose except to show. These are called fancy breeds. To this class belong such breeds as the Bantams, the Silkies, Frizzles, and a few others of less importance. These will not reward

the keeper unless he expects to win prizes or something of the kind with them. They are not recommended to the farmer as worthy of his attention.

Standard Bred Utility Hens for Profit.—It should be the purpose of every fancier or grower to breed birds for utility purposes, but this is not the case. The best birds out of a flock are kept for show purposes, while those a little off in color are sold as utility birds.

In fact, those birds that do not come up to the show standard are put aside and sold for utility stock. This puts utility below other features of breeding. The most important quality is utility and a bird that does not come up to a high standard of utility should be discarded, and not sold. To



GOOD TYPE OF GENERAL PURPOSE FOWL.

breed utility birds we must have trap nests and keep close accounts with them. When they do not come up to the standard of egg production, we should discard at once and replace with another and a better. The utility bird is the foundation stock for the farmer.

Care of Chickens.—They should have a close house, well ventilated, and so arranged that

plenty of sunshine can get in. The yard should be closed on north and west by a board fence and should slope to south or east if possible. This will keep the chickens in better health and often keep them laying all winter. In summer, they require plenty of shade and cool water.



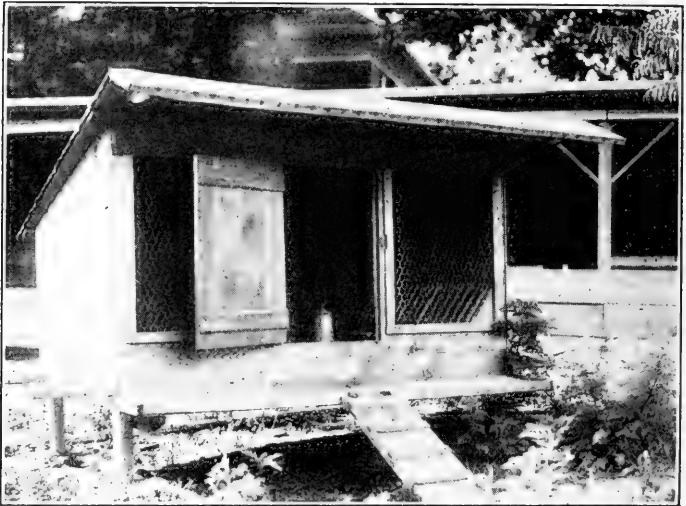
BEAUTY AND UTILITY COMBINED.

Houses for Chickens.—A house for chickens should be dry, it should have plenty of sunshine, it should be free from drafts, it should be built tight on three sides, and should face south or east. The fourth side may be covered with wire and have a drop door that could be used during cold weather. If anyone of these considerations should be left out, chickens will not thrive very well.

Feeding Chickens.—It will not do to give chickens that are enclosed just one kind of food

such as wheat or corn. This is not sufficient. There must be given some animal food, and on the average farm this part of the diet is supplied; the chickens eat all kinds of insects and get the meat scraps thrown from the table.

Of course, chickens must have a great deal of

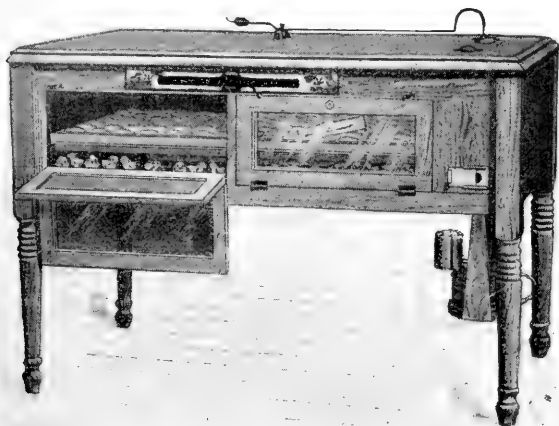


A MODEL CHICKEN HOUSE.

green stuff to counterbalance this meat ration. This is essential to keep them in health and especially to keep them laying.

Pastures.—The yards that are usually planted in small grain for chickens ought to be made large enough to give the chickens plenty of green stuff for winter diet. The average yards are so small that the chickens keep them as clean as a swept

yard. There is nothing better for them than the young small grain, but rape, clover or vetch may be planted, and will give practically the same results. Then a larger pasture will give the chickens larger runs, and keep them in better health. On the farm this will be overcome by letting them run loose part of the time.

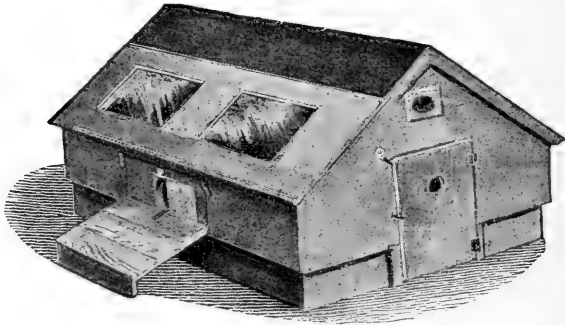


THE ARTIFICIAL HATCHER.

Raising Young Chicks.—Where we are going to raise only two or three hundred chicks in the year it is usually better to hatch the eggs with hens instead of an incubator, but if we have larger numbers it would pay to use the incubator. The rule is that if we have the non-setting hens, or if we raise a large number of chickens, it pays to have an incubator, but otherwise it does not. As a substitute for incubators, when we have Leg-

horn hens, it might pay to get a few heavy hens for setting.

Results to be Expected.—We shall never get great results with poultry till we invest more thought and a little more money in it. It is a big paying business when it is properly looked after, but will never amount to much until we go into it with a knowledge and will. Good results will



BROODER—THE INCUBATOR CHICKS' NURSERY.

follow good efforts. No farmer should deny himself the pleasure and profit of raising poultry on a small scale, and the matter should not be treated lightly like it has been treated in the past. All of us have been far too indifferent about this important branch of Agriculture.

CHAPTER XXXVI. SCHOOL GARDENING.

School gardening is a subject that has engaged the attention of many educators in recent years, and is coming to be looked upon as a necessary supplement to school work. It is one of the shortest and best ways of getting interested in and in sympathy with nature. To be able to get out to chop, dig, and hoe a little among the plants we have planted with our own hands is to quicken the latent powers of observation and this is what we wish to do in undertaking to develop a school garden.

Every school should have some kind of a garden, whether for growing ornamental or for otherwise useful plants, and often such a garden can be made to pay a handsome annual income when well operated. "There are about 1,000 school gardens in connection with the country schools in England", observes Miss Sipe of the Office of Experiment Stations, "to inspire and teach the boys and girls of rural England the elements of Agriculture and Horticulture".

Selection of Ground for School Garden.—

It would be far better to have none at all than to have a poor school garden, as the people in every neighborhood are always wishing something to talk about and any kind of failure in the school circles will afford much for comment and criticism. Therefore it is well to select a rich and easily cultivated plot for the garden. The aim will be to get plants to grow and get them to grow



MAKE THE SCHOOL GROUNDS PLEASANT AND ATTRACTIVE.

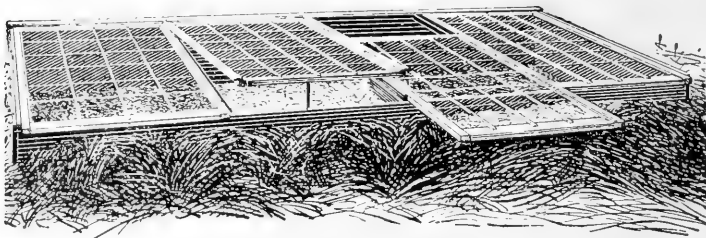
well. Poor plants make a poor showing, and good ones always cause favorable comment. Ordinarily, the spot selected for the school garden should be toward the rear of the school house, if other conditions favor this.

Size of Ground for Garden.—This will depend on several things, the most important of which is the size of the school and the number of grades in same. It ought to be arranged so that the plots could be given out by grades and each grade have a certain crop to grow. This has worked well, and shows the possibility of making many crops on a small area. We should then assign each pupil so much ground. In England each pupil is allowed one square rod of soil, and all the plots are laid out by the boys as a preliminary lesson. The most desirable shape for these individual plots is rectangular, letting them be very narrow and long. In some schools, narrow streets are run through the plots, and each individual plot about $2\frac{1}{2}$ feet by 8 feet. This part may be left to the individual taste of the teacher and pupils.

What to Plant.—Other things being equal, we should by all means plant such crops as can be gathered while school is in session. If this cannot be done, we must make the best of the situation. Crops common to the community in which the school is located take first place. The purposes of the school garden are to teach how to improve plants already growing in a community as well as to introduce new crops, and of course there must be no neglect of crops already in existence. Suggestions are made elsewhere how to arrange for

such crops as cannot be gathered during the session of the school. If rapidly growing vegetables do not take up all the space of the garden, and it should not, we must not hesitate to put farm crops on our ground, such as corn, cotton, potatoes, sweet and Irish, and even small grains. Much good will result in the habits of observation that may be developed.

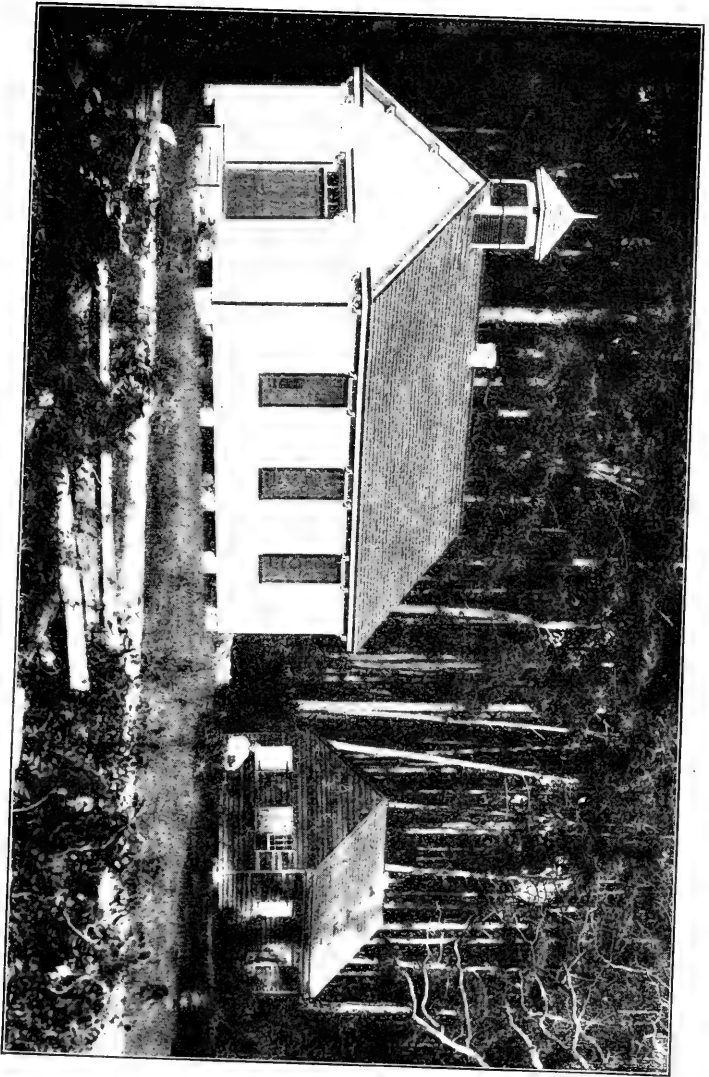
Cold Frames and Hot Beds.—In connection with every school garden there should be at least one cold frame and one hot bed. The cold frame may be used for growing cold weather plants



HOT-BED, SHOWING FRAME AND SASH.

during winter months. In this we would have lettuce, radishes, chard, kale and young cabbage plants. Teachers will find it exceedingly interesting to give lessons from time to time on the value of these plants both as food and as table decorations, and pupils will appreciate them very much. If the frame should be a rather large one, say about 6 feet by 30 feet or 40 feet enough lettuce can be sold from it to buy a valuable chart or map for the school room.

Hot beds are about the same as cold



THE OLD-TIME SCHOOL, AND THE NEW ONE.

frames, except they are a little deeper and must have a heavy layer of barnyard manure on the floor or bottom, which produces the heat for the tenderer plants and at the same time a place for them to grow in. All our young tomatoes, peppers, egg-plants, and other tender crops must be forced in the hot bed, and made ready for resetting in early spring as soon as the cool weather is over. The boys can make these, by bringing spades, shovels, saws, hammers and nails some Saturday. The depth should be about two feet below the surface level and a good, solid, wooden frame made in this. Posts should be about 4 or 5 feet apart and stout boards nailed on them. Fill up on the outside, make one edge of the top about a foot or more higher than the other so it will shed rain readily. Then fill with earth up almost to the top of the outside, so the water will be less likely to run in and stand in the frames. Cover with light boards or cheap sea island cloth. Ribs should be run across the frame every few feet to hold the cover up, especially if it be made of cloth.

Revenue from Young Plants.—It must be remembered that a school garden is conducted in connection with schools primarily for the purpose of teaching how to get results from all gardens, and to help pupils to think about why certain crops are cultivated or fertilized differently from others in order to get the best results. In addition to this, the teacher can show how home and school gardens can be made to become a source of revenue. Young tomato plants, peppers and egg-plants are quite salable in the spring when every-

body is fixing to start the home garden, and if the school has such plants ready, many thousands can be sold and the proceeds go to building up the school library. Get the thought and it is easy to get the results. Some schools have cleared as much as \$65.00 in one spring selling young garden vegetables for resetting in the home garden. Cabbages that are to be thus sold must be put out very early after January, if not in the fall. Tomatoes, and peppers should be seeded in the frame about February 10th or 20th, depending on the latitude, altitude and climate.

Fertilizing Beds or Plots.—When our plants are ready to be transferred from frames to plots, our land should be well spaded and fertilized. The nature and kind of fertilizer should be determined by the crop itself, and a table is given in the back of this book showing formulas for most farm and garden crops. Where possible, a wheelbarrow load of some kind of barnyard manure should be put on each plot that is allotted to a pupil. This will cause the plants to do much better and therefore bring success to the work. Only a few pounds of fertilizer will be needed for the whole garden, and perhaps only about two pounds for each plot of $2\frac{1}{2}$ by 8 feet. A little nitrate of soda may be scattered in the bed a little later, or in one half of each bed leaving the other half without it, to show the pupil the results of such an experiment.

Implements to be Used in Cultivating Plots.—It has already been stated in this book that every school should have a set of garden tools as object

lessons. Some day, a small set of such tools will be required just as a third reader is required at present. Pupils will be required to keep such implements on hand. The tools necessary to cultivate school gardens are a hoe, rake, spading-fork, shovel, pitchfork, and hand-plow. Several other implements can be used to advantage, but the above is the minimum. The time of cultivation, as well as planting can be worked out just as spading and breaking the plots may be. Do



EVERY SCHOOL SHOULD HAVE AN ANNUAL FAIR—
THIS ONE IS IN A SCHOOL IN BRAZIL.

not be afraid to put out such plants as cabbage in mid-winter. The cold weather does not hurt them and they will grow the more rapidly the earlier they are put out.

If parents object to the purchase of garden implements for their children, the teacher can arrange to purchase same on credit at some grocery store in the nearest by town and let the pupil pay for it with lettuce and other salable

vegetables. This has been done in many places and has inspired the young people to do their best work.

Pots and Boxes for Growing Flowers and Vegetables.—It is quite easy to give valuable lessons in nature study and gardening by the use of pots and boxes to grow plants for demonstration lessons. Ornamental plants, garden vegetables, and other forms of vegetable life can be grown in them and many of them sold or reset in home gardens. The school should perhaps undertake to supply every garden in the community of the school with a complete variety of garden vegetables at the proper time for planting the home garden. This can be done without cost, and it will win patrons to the work of the school. Pupils should be taught how to put out the young plants so they can get credit at school for such work done at home when the parent informs the teacher that it has been successfully done at home. Why do not country homes have more vegetables, a greater variety of them, and have them a longer period of time through the year? It is perhaps because it has not occurred to them that this is a very easy thing to do, and that it costs scarcely anything at all.

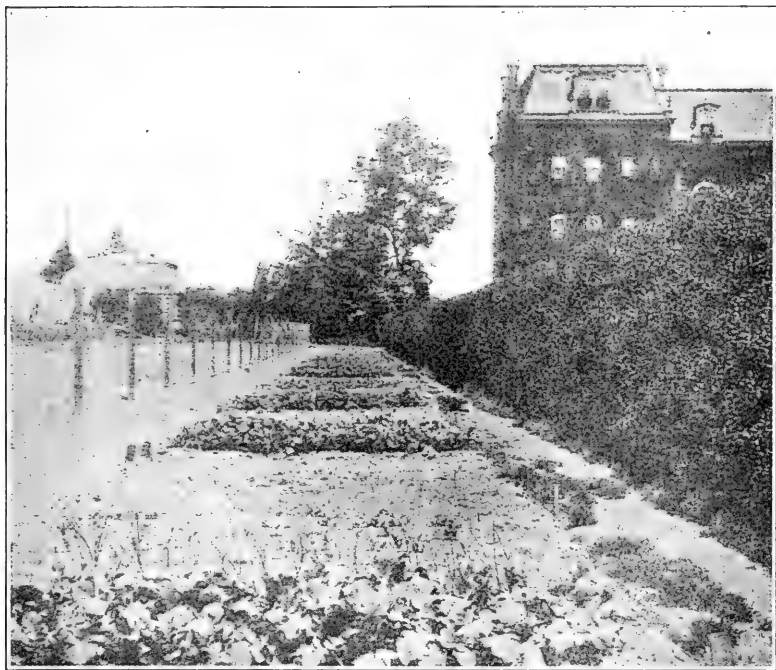
The Duty of Teachers in Such Matters.—If a teacher goes into a community to instruct, he or she should carry a consciousness of a great responsibility into the community, and make it a point to leave nothing undone that would tend to make life easier, and health surer in the community. Pupils must see that school is directly connected

with home activities, and they are learning to live happier in the home if the school is a success. This question of supplying young garden plants for home planting, will often be the means of welding the school and home forever together. The next step may be to have patrons come out on Friday and discuss methods of gardening and trucking. In this way, clubs can be organized among the older people that will in every way promote the interest of the school and the home.

Flower Gardens.—Certainly no school should be without a flower garden. The arrangement of a flower garden can be left largely to the ingenuity of the teacher and pupils, but some general suggestions will perhaps guide us in the initial work. In some convenient place near the front or on one side or both sides of the school house, have the boys measure off the space necessary for the flower garden or gardens. There should be at least enough space in this plat for some plants for every pupil in the school. For roses and shrubbery there should be something like 300 square feet of land, measuring about 10 feet wide and 30 feet long. For bulbs, there should be at least two and better four smaller beds, near the entrance to the front of the school house. These should measure about 3x6 or 4x8 feet, or if in some convenient corner, they need not be so formal in shape, but may fit in any where the room can be spared; only see that they are not shaded too much by fences or trees.

All these beds should be thoroughly spaded in late winter before the cold weather is over, and

fertilizer and manures thoroughly worked into the soil. Sweepings from some cowpen will make the very best manure for the bulbs. The bulbs should consist of hyacinths, daffodils, jonquils, tulips, crocuses, narcissi, and others that may be



SCHOOL GARDEN PLATS, FROM U. S. FARMERS' BULLETIN NO. 160.

selected by the pupils themselves. Some cannas, coleis, and dahlias will help to make out the variety. These latter will be more useful near the house, or even to bank up against the house, let-

ting the cannas be first, the colei next, and last, or furthest from the wall, dahlias.

For the larger bed we may use roses, japonicas, lilacs, spiraea, arbor vitae, and several other kinds of shrubs as may be suggested by pupils or teacher, or some good catalogue. Get shrubs when possible from the homes of the pupils. This will place the school in a very happy relation with the homes. Pay back for these plants when the young garden plants are ready for replanting later in spring.

CHAPTER XXXVII.

NATURE STUDY IN THE COMMON SCHOOLS.

Weld nature study and Agriculture and you have gone far toward making a happier and thriftier population, wherever you may be. The ancients learned: "Nature will soon change all things which thou seest, and out of their substance will make other things, and again other things from the substance of them, in order that the world may be ever new". This is a useful and a beautiful lesson, and blessed is he who can see ever and anon the newness in nature.

Dr. L. H. Bailey well says: "The nature-study idea is bound to have a fundamental influence in carrying a vital educational impulse to the farmers. The accustomed methods of education are less applicable to farmers than to any other people, and yet countrymen are nearly half of our population. The greatest of the unsolved problems of education is how to reach the farmer. He must be reached on his own ground. The methods and the results must suit his needs. My plea is that new educational methods must be employed before we can really reach the farming communities. I am not insisting that we make more farmers, but that we relate the rural school to the lives of the people and that we cease to unmake farmers."

Objects of Nature Study.—The greatest object of nature study is to get us to thinking about the things about us; to relate us, so to speak, to the

world in which we live. We may say that to know that the house fly is a carrier of diseases of all kinds is to appreciate the importance of warring against him. To know that insects and fungi will destroy our crops if we do not make war on them is to have better crops. To know that it is impossible for our plants to succeed in the warfare against insect life without birds to eat the insects, is to protect bird life and thereby save the trees. What is all this strife in nature for, anyway? Have we ever taken time to stop and think that man often stands in his own light by not knowing just what step to take next? Nature study will help us to move off in the right direction and win in this great battle. It will prepare us to recognize and aid our friends, and to make war against our enemies in this gigantic struggle. Let's make this chapter one of the liveliest in the whole book, and see how it will help to make many others seem more delightful.

Methods of Pursuing the Study.—Every school should be a special collecting house for all kinds of natural objects; such as cocoons, old birds' nests, wasp nests, insect galls, peculiar plant growths, and all kinds of insects, especially injurious species, and the various rocks that are exposed about the school house. It would not be possible to mention just here the great number of items that could be collected in a short season. Each grade or class might be held responsible for collecting a certain class of objects, and in this way very pleasant rivalry could be made to stimulate the several classes to get a fine collection. The

effect of this will be surprising. It will also be interesting to see in a short time how many things in nature that we ordinarily pass unnoticed prove quite interesting.

Make each class of objects a subject of special study for one, two or three days, and then return to these in regular order if the necessity should arise.

We shall never find success trying to teach nature study without having a laboratory of living things as well as other objects. The school garden, pot plants, and flower beds should constitute part of our living laboratory, and should be visited from time to time and made part of our regular work,—not merely things about which to show curiosity, or to give an excuse to get out of an hour's work.

The Larger Things a Part of Nature Study.—

With some teachers, only the smaller things about the school house and the home are considered among the objects for teaching nature study. These are good as far as they go, but surely we shall not try to limit the child's mind to the near-at-hand objects and let the larger things of nature go unnoticed.

A lesson for a rainy day should be composed of a short paper by each pupil in the class on clouds. What are clouds? How are they formed? Are there several kinds of clouds? Are clouds useful as well as beautiful? How is water taken to plants in places where they do not have clouds? Are clouds always blessings? How about floods? Sometimes we say a cloud has a great deal of wind in it. Is this literally true? What is the cause of

the rapid movements in the atmosphere? Get the dictionary and find out the difference between fog and cloud and steam.

We shall learn to appreciate and love the earth as a unit only as we see it riding through space at the rapid rate of more than sixty thousand miles an hour, and moving from West to East at the rate of twenty-five thousand miles in twenty-four hours.

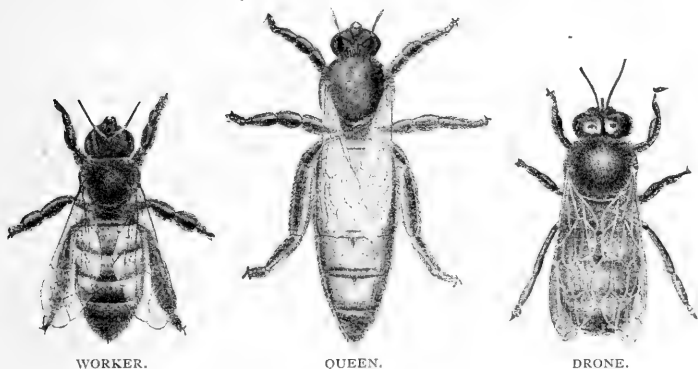
Some one will volunteer to write a lesson on the beauty of the stars. We must not forget what Emerson said about the stars: "If the stars should appear one night in a thousand years, how would men believe and adore, and preserve for many generations the remembrance of the city of God which had been shown! But every night come out these envoys of beauty, and light the universe with their admonishing smile."

The Honey Bee.—If possible we must have a hive of bees somewhere in the neighborhood so we can visit it. A colony should be exhibited under glass near the school in working season, and the whole school have access to it daily. A hive in perfect balance consists of a single queen, several thousand workers and in certain seasons a few hundred drones. The queen will be found on the most crowded comb, and will be distinguished by her long, slender, and graceful body, with short wings going not more than half way the long body. The wings of working bees cover the body. The drones are broad and heavy and are awkward looking bees.

Bees are not only useful in making honey for

our table; they are important agents in the fertilization or pollination of plants. When visiting flowers to get the honey, the pollen sticks to them and is thereby put on the stigma or female organ of that or a neighboring flower. The honey is carried to the hive in the crop, and that large yellow patch you may happen to see on the hind leg of the bee is pollen from the flowers and is to go into bee-bread.

A good queen lays about 2,500 eggs daily, one



WORKER.

QUEEN.

DRONE.

in each cell of the comb. This tiny white speck hatches out on the fourth day and makes a white larva or maggot, which is fed constantly by the worker bees till about the ninth or tenth day, when it spins a cocoon and forms into a chrysalis. On the twenty-first day the chrysalis comes out a young bee. Nothing will prove more interesting and instructive than to watch a hive of bees closely for a season.

The Toad.—Professor Hodge of Clark Uni-

versity has found many interesting facts about the common toad that are not generally known. He built a small pen in his garden and put in it two toads in a pan of water and placed some bits of meat and bone near the pan. Of the toads he has the following to say: "They spent most of the time sitting within reaching distance of the bait, and killing the flies attracted by it. I watched one toad snap up eighty-six house flies in less than ten minutes.

"One day I gathered a quantity of rose bugs in a tin box and began to feed the bugs to a toad. At first I did not count, but finding his appetite so good I started to count. When I had counted over eighty bugs and the toad showed no signs of wishing to conclude his meal, I picked him up. Previous to my beginning to count he had taken anywhere from ten to twenty bugs. I found the toad equally greedy for rose beetles, canker worms, ants, caterpillars, moths, June bugs, weevils, snails, and many other insects."

We also learn from Prof. Hodge that farmers in England pay \$24.00 per hundred for toads to have them placed in gardens and flower beds. Toads destroy many cut worms, and in this way may be worth in a season as much as \$19.88 apiece to a farmer.

Have you heard the blinking toad
Sing his solo by the river
When April nights are soft and warm,
And spring is all a-quiver?

There is no reason why we cannot have some real fun and get some good information by ex-

perimenting with the toad in the school grounds. A small pen will be made of fine mesh wire by the boys, about 6 feet square, and a basin of water put in this. Some sweet or fresh meat will be placed near the pan. At the rest period of school, the class will go and observe the habits of Mr. and Mrs. Toad. Notes should be taken, especially of the number of times they catch food. They eat most of their food at the close of the day and in the night, so not much will be seen in the middle of the day.

The Bumble-bee.—The bee to which we refer is the one that comes around the house in early spring to tell you that winter is gone, and stands in space without a lighting place, and apparently without motion. This is a most intelligent insect. We are all to be on the lookout for his nesting place. If this happens to be in some convenient place, we shall bring it into the school house if it can be detached. We must saw longitudinally through and see just how the bee digs out his home. By watching him carefully, we can see his methods of carpentry. He goes from directly below through the piece of timber selected for his site, about three or four inches, and then goes to the end of the timber in many cases, and comes for about ten or twelve inches directly to the upper end of the opening from below. You will not be able to tell just where he stopped the vertical or horizontal holes, so perfect has the work been and so well directed has been the blind instinct. This is a wonderful lesson and should not be missed.

Why Study Nature?—This will suggest that

we might have put this information under the heading, "Objects of Nature Study," but it is different. If we take a wheel from a watch, we can learn very little about it, if it is detached from the watch. We must study the other wheels in the watch, especially those nearest the wheel in question, if we ever expect to know this one. "Man therefore seeking to know himself, must fail utterly, unless he remember that he is only a part of the great machine of the universe. He must therefore study the other wheels, that is, the life-forms about him which are parts of his environment and offspring of the same creative power of himself." When we consider that we are a part of nature, it must appeal to us that it is important that we study nature, else we cannot study ourselves.

"I believe a leaf of grass is no less than the journey work of the stars;
And the running blackberry would adorn the parlors of heaven,
And the narrowest hinge in my hand puts to scorn all machinery,
And the cow crunching with depressed head surpasses any statue,
And a mouse is miracle enough to stagger sextillions of infidels,
And I could come every afternoon of my life to look at the farmer's girl
boiling her iron tea-kettle and baking short-cake."

There is no study that will prove more interesting than nature study if we will only learn to observe the relation of things about us in nature. The next chapter will contain some suggestions that if followed out will help us to get in sympathy with one phase of nature and at the same time bring much happiness and many resources of life to us.

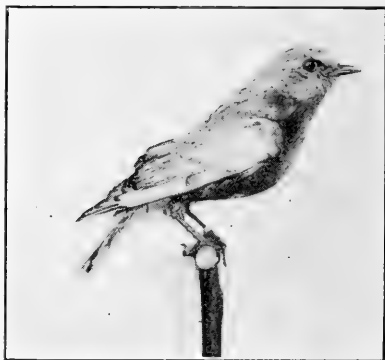
CHAPTER XXXVIII.

BIRD LIFE.

We must stop for a moment and wonder if boys are still like they used to be. To acknowledge that they are is to have to confess that we are slow in our processes of civilization. Only about twenty-five years ago, boys thought that birds were made only for boys to shoot at in learning how to use a gun, or sling shot, or cross-bow. In fact the birds are almost as indispensable in the ample field of nature as we boys are. Why is it that girls have never enjoyed killing birds like boys? They seem not to be so brutal as we are. We must learn now that it pays to protect and enjoy the birds. They were made for a serious and noble purpose, and we must try to learn what this is.

Simple Experiments in Bird Study.—First of all we must not kill a bird for this study unless we have to do so. Let each of the boys select a different bird for study. Secure a small note book and make an accurate record of his knowledge of the bird. This record must be read in school about April 1st to 15th. Agree to watch the bird at least part of each day for two or three days and note exactly how it behaves, what it eats, how it flies, where it lights, its song and call note (if it happens to be singing in April). This little experiment will prove more interesting than we had thought. We may be free to use all the literature on the subject of birds that we can find.

Why Study Birds?—We should study birds because they are so completely woven in with man's history and happiness. They are the natural enemies of injurious insects, and there is some doubt if man could grow things upon the earth without the aid of birds in the warfare against these millions of insect pests. Because of their beauty, birds arouse in us that natural interest in and love for the animal kingdom to a degree that perhaps could be reached in no other way. The bird adds beauty to the landscape and makes a walk into the woods more inviting and wholesome. We feel that we have friends on all sides, after we begin to know something about birds, and this makes the study a very useful as well as a beautiful study. Nothing in the great world of nature about us even compares with the birds in interest and usefulness and how can we longer delay to make a close study of them in their relation to human life. Some of the suggestions that follow will give us additional reasons why we should follow up these lessons on birds.



THE BLUEBIRD—ONE OF THE MOST FAMILIAR AND USEFUL OF OUR FEATHERED FRIENDS.

Birds and Insects.—It is estimated by entomologists that insects destroy in the United States

alone five hundred million dollars' worth of agricultural products annually, aside from the immense cost of spraying outfits and sprays used in the warfare against them. The insectivorous birds in Massachusetts destroy 21,000 bushels of insects a day during late spring, summer and early fall, and are estimated to do half this good during the winter eating the scales and insect eggs. At that

rate, it is hard to estimate the enormous number of insects eaten every day of the year by the great army of birds in the United States. Try to consider then what the birds do for us on any summer day, when insects are so abundant that the hum of their united voices becomes an almost inherent part of the atmosphere. But if this great army of insects is left to do its full capacity of destruction, the



THE SPARROW HAWK AND SOME SPARROWS
HE EATS—THIS BIRD ALSO DESTROYS
MANY RATS AND MICE.

question of raising field and garden crops would prove too big a problem for man. In other words, there is doubt as to whether man could prosper on the earth without some aid in the war-

fare against these small creatures. The birds are the most useful of all natural agencies in the warfare against the insects, and should be protected in every possible way.

How Birds Feed Upon Insects.—For a general classification of birds according to their methods of feeding the following will answer: Those that feed in the open air, those that feed among trees and shrubbery, those that feed upon trunks and branches of trees, and lastly those that feed upon the ground.

To the first class belong the swallows, swifts, night-hawks, and whip-poor-wills.

To the second class belong the fly-catchers, warblers, and vireos.

To the third class belong the woodpeckers, nuthatches, and creepers.

To the fourth class belong most of our walking birds such as larks, blackbirds, quail and doves.

There are many useful birds that may not come under any one of the above classes, but it was not intended to suggest a complete list. The



A FAMILY OF CARPENTERS.

above is, however, a good working list. In order to make the study interesting, we must learn thoroughly at least two birds of each of the above fourteen groups.

Some Birds That Eat Certain Insects.—This is the part of the study that we must learn for ourselves, but to give the following information will not hinder us from getting first hand information along the same line. Certain birds are known to prefer certain kinds of insects for their meat supply while others have an entirely different menu. This difference no doubt is due largely to the question of supply and demand. Birds will naturally cultivate a taste for certain kinds of food, if other supplies happen to run short. The following suggestions have been given out by a number of authorities on economic ornithology and combined by Mr. E. H. Furbush, Ornithologist to the State Board of Agriculture of Massachusetts:

The chickadee holds in check the tent caterpillar by eating the eggs.

The white breasted nuthatch feeds largely on scale insects and their eggs.

The wood peewee feeds on moths, beetles, flies, gnats, mosquitoes and other small flying insects.

Robins, and catbirds eat the famous cecropia moth, one of the worst enemies of groves and orchards.

The cuckoo is famous for its love of the hairy caterpillar.

The Mexican cotton boll weevil is eaten by at

least thirty-eight species of birds, the most active among these being the oriole, nighthawk, martin, bank swallow, barn swallow, rough wing swallow, and cliff swallow.

This could be multiplied indefinitely, but to say too much about it would possibly keep us from seeing more of what birds eat. We must actually get out in the field and see just what birds do eat. Flagg says that each species of bird performs certain services in the economy of nature, which cannot be so well accomplished by any other species. It is therefore important that we protect all the birds in order that we do not make a fatal error by destroying some species.

Bird Migration.—One of the most interesting things about bird life is migration, or passing from zone to zone as the seasons roll by. In early spring they wend their way northward day by day till some of them reach the north shore of Labrador. In the autumn southward they come in great bands by day and by night. How happy is one who knows when to look for these passing bands of birds and can be out and see them, and name them. What is the cause of this great movement of birds from one section of the globe to another? An answer to this would be almost impossible, but many have suggested some reasons why birds migrate. Some claim that it is a search for a supply of food on which to rear the young, while others think it is only this “homing instinct” to get back to the place of their birth before rearing the young. Many factors no doubt play some part in causing birds to migrate. Shall we let them go

by season after season without getting a glimpse of them? A table of migrations should be posted in every school in the United States so our happy young people could have some basis for a study of bird migration. A table will be found in Chapman's Handbook of Birds of Eastern North America, and some

good pupil may copy it off for part of his or her monthly examination.



MOCKING BIRD, HUMMING BIRD AND JOREE.

Bird Song.—Have you really ever stood and listened to the song of a wood thrush? Do so, and then try to analyze this heaven-sent melody. You will never thereafter escape the calming influences of bird music. It is so beautiful and free and wholesome that we should never miss it

when it comes into our community. Some birds sing almost all the year while the great majority of the species sing only about nesting time. Bird students seem to agree that the song instinct of birds is very closely associated with their mating, the time of the year that they seem most happy. The song proper must be differentiated from the

call notes of birds. "The call notes," observes Mr. Frank Chapman, "are the birds' daily language, while the true songs are only outbursts of emotion." It is quite important therefore that we know the call notes as well as the songs in order to be on good terms with the birds.

"The beauty of birds, the music of their calls, the majesty of their soaring flight, the mystery of their migrations, have ever been subjects of absorbing interest to poets, artists, and nature lovers everywhere. Prominent among the undying memories of men are mental pictures of the birds of childhood, their coming in the spring, their nesting, and their chosen haunts. Many an exiled emigrant longs in vain to hear again the out-pouring melody of the sky-lark as it soars above the fields of England."

TO OUR MOCKING BIRD.

Trillets of humor, shrewdest whistle-wit,
Contralto cadence of grave desire,
Such as from off the passionate Indian pyre
Drift down through sandal-odored flowers that split
About the slim young widow who doth sit
And sing above—midnights of tone entire—
Tissues of moonlight shot with songs of fire;
Bright drops of tune, from oceans infinite
Of melody, sipped off the thin-edged wave
And trickling down the beak—discourses brave
Of serious matter that no man may guess—
Good-fellow greetings, cries of light distress—
All these but now within the house we heard:
O death, wast thou too deaf to hear the bird?

SIDNEY LANIER.

CHAPTER XXXIX.

CO-OPERATION IN AGRICULTURAL WORK.

After many years of planning and study on the subject of extension work in all Agriculture, most authorities seem to come to the same conclusion, that co-operative work and demonstration work, together with the formation of clubs, must eventually be the solution of the problem of farm improvement. Among the various clubs



EVERY FUTURE FARMER SHOULD ASPIRE TO A COLLEGE EDUCATION.

formed to promote this kind of work are the Boys' and Girls' Clubs, Farmers' Co-operative Demonstration Work, College Extension Work, and Co-operative Live Stock Associations, as well as many other organizations of a similar nature. This movement is a new movement, but is sure to revolutionize Agriculture within the next few

years. We have long since learned that very few people can get the benefits of a college education, and in order for a college to serve the whole people it must make every effort to reach them through the medium of organized clubs. The Department of Agriculture has felt that it can render no greater service than to carry the news and methods of scientific Agriculture to the farming communities, and what it has accomplished in this line under the late Dr. Knapp fully justifies all efforts.

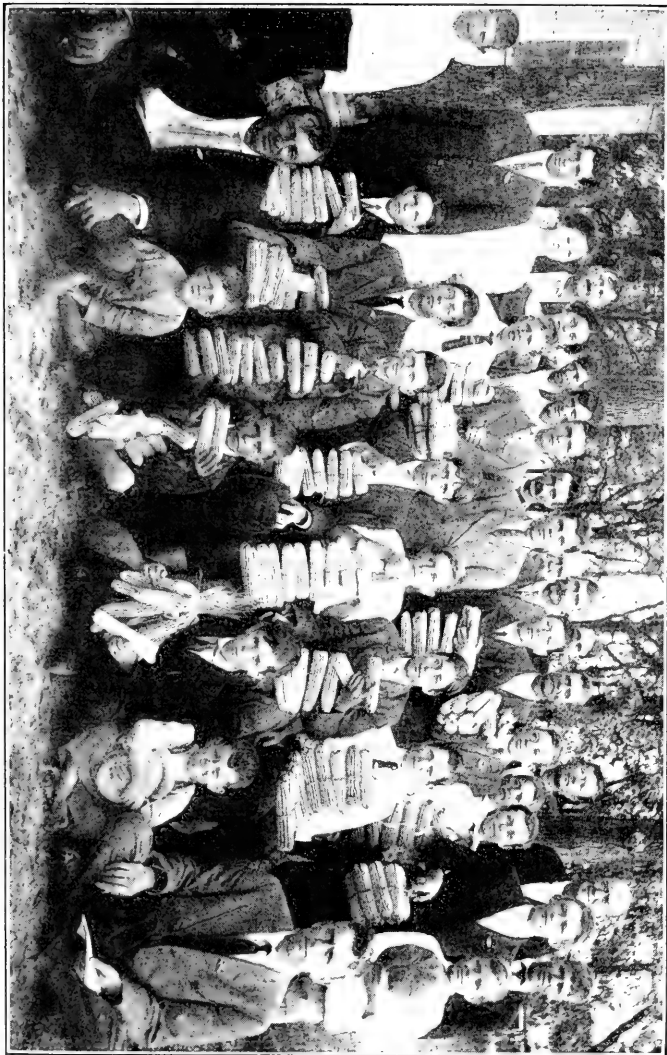
Boys' Corn Clubs.—Every school should aid in the organization of a boys' corn club. This is easily done and may be the means of making a far better school. In order to do so, get in correspondence with your State agent usually located at your State College of Agriculture. He will forward blanks for memberships in these organizations, and co-operate with teachers in perfecting the organizations. The Department of Agriculture gives the following purposes for organizing boys' corn clubs:

(1) To afford the rural teacher a simple and easy method of teaching practical agriculture in the school in the way it must be acquired to be of any real service, i. e., mainly by actual work upon the farm.

(2) To prove that there is more in the soil than the farmer has ever gotten out of it; to inspire boys with a love of the land by showing them how they can get wealth out of it by tilling it in a better way and thus be helpful to the family and the neighborhood.

(3) To give the boys a definite, worthy purpose and to stimulate a friendly rivalry among them.

The following rules may be adopted by a club, with such modifications and additions as may be found necessary:



BOYS' CORN CLUB IN HOUSTON COUNTY—BUILDING FOR THE SOUTH'S FUTURE PROSPERITY.

(1) Boys joining clubs and entering contests must be between 10 and 18 years of age on January 1 of any given year.

(2) No boy shall contest for a prize unless he becomes a member of a club.

(3) The members of the clubs must agree to study the instructions of the Farmers' Co-operative Demonstration Work.

(4) Each boy must plan his own crop and do his own work. A small boy may hire help for heavy plowing in preparing the soil.

(5) Exhibits must be delivered to the county superintendent of education on or before November 1.

(6) The land and corn must be carefully measured in the presence of at least two disinterested witnesses, who shall attest the certificate of the boy.

(7) The entire crop of corn should be weighed when it is in a dry condition. Two 100-pound lots should be weighed from different parts of the total. Weigh the shelled corn from these two lots in order to find the average percentage of shelled corn. Multiply the total weight by this percentage and divide by 56 in order to get the total number of bushels. In cases of large yields the moisture content should be ascertained. Doubtless the agricultural colleges will be glad to make such tests. If not, apply to the Demonstration Bureau and it will be arranged with the proper office of the Department of Agriculture.

(8) In awarding prizes the following basis shall be used:

	Per cent
<i>a.</i> Greatest yield per acre.....	30
<i>b.</i> Best exhibit of 10 ears.....	20
<i>c.</i> Best written account showing history of crop.....	20
<i>d.</i> Best showing of profit on investment based on the commercial price of corn.....	30

It is a good plan to have *a* and *b* judged by a committee of farm experts and *c* and *d* by a committee of school officers and teachers. Their combined judgment can be made very helpful.

Girls' Canning Clubs.—In some States the girls' club work is in charge of a special expert located at the State College of Agriculture, where the advantages of co-operative publications in the form of bulletins and the ready advice of specialists are always available. This proves an ideal arrangement from the standpoint of administration work. This work comes under the State Agent for Farmers' Co-operative Demonstration

Work through whose office is usually held a State contest for prizes. The purposes of the girls' clubs have also been outlined by the Department of Agriculture as follows:

(1) To encourage rural families to provide purer and better food at a lower cost, and utilize the surplus and otherwise waste products of the orchard and garden, and make the poultry yard an effective part of the farm economy.

(2) To stimulate interest and wholesome co-operation among members of the family in the home.



CAN YOUR PEACHES AND HAVE FRUIT DIET THE YEAR 'ROUND.

(3) To provide some means by which girls may earn money at home, and, at the same time, get the education and viewpoint necessary for the ideal farm life.

(4) To open the way for practical demonstrations in home economics.

(5) To furnish earnest teachers a plan for aiding their pupils and helping their communities.

The county is the proper unit for organization of clubs. This unit may be subdivided into dis-

tricts according to centers of population and natural barriers, so as to place a club within the reach of every girl in the county, if practicable.

The plan of this work should usually be presented to the county teachers' association by the proper authorities. A leader may be selected from among the teachers with the assurance of co-operation from local and district agents and county agents of the Farmers' Co-operative Demonstration Work. These agents are paid to promote the welfare of Agriculture in the county, and will have instructions from the State Agent to help the local clubs in their organization work.

(1) Girls joining the clubs must be between ten and eighteen years of age. The age for any year will be fixed by the age of the girl on January first of that year. Special classes may be organized for older girls.

(2) No girl shall be eligible to receive a prize unless she becomes a member of the club and plants a garden containing one-tenth of an acre.

(3) The members of the clubs must agree to study the instructions of the United States Department of Agriculture, and such other instructions as may be sent them from co-operating sources.

(4) Each girl must plan her own crop and do her own work. It will be permissible to hire heavy work done, but the time must be charged.

(5) In estimating profits the following uniform prices must be used: One dollar for rent of land; ten cents for each hour worked; two dollars a ton for stable manure; and actual cost for commercial fertilizer and other things purchased or furnished.

(6) The garden and products must be carefully measured and two disinterested witnesses must attest the report submitted at the close of the season.

PRIZES AND AWARDS.

The award of prizes and honors shall be based on the fresh and canned products of the garden according to the following schedule:

1. Quality.....	20 per cent
2. Quantity—pounds vegetables harvested and used.....	20 per cent
3. Variety of canned product.....	20 per cent
4. Profit.....	20 per cent
5. Written history, account or composition—"How I made my crop.".....	20 per cent

Poultry Clubs.—It is a well-known fact that the raising of chickens can be made a pleasant and profitable business, and that fresh eggs always have a ready marketable value. The object of forming poultry clubs is to emphasize the value and importance of this much neglected industry, and to co-operate in an effort to secure for market a uniformly excellent product. Usually some one connected with the State College of Agriculture or with the Department of Agriculture in Washington will help with poultry club organizations, and every girl in a community should belong to such a club even if she already belongs to a canning club or any other club. When such clubs are organized, regular meetings should be held from time to time and the problems of the industry discussed.

It will be well to have a president, one or more vice-presidents, and a secretary. A simple constitution and by-laws should be adopted. It will be found profitable to subdivide the county organization by townships, schools, or school districts, and have local meetings at school houses or at different girls' homes occasionally. Each club should adopt the following general regulations:

1. Girls joining the club must be between 10 and 18 years of age on January 1 of any given year. Special classes may be organized for older girls.

2. No girl shall be eligible to receive a prize unless she becomes a member of the club, and sets at least one sitting of 15 eggs.

3. Each member of the club must agree to study the instructions of the United States Department of Agriculture.

4. Each girl must plan to do her own work and keep strict account of all expenses, such as feed, labor (for which 10 cents an hour should be charged), sale of stock, etc.

SUGGESTIONS TO MEMBERS.

To rid the poultry house of mites, spray the pen, the roosts, and the dropping boards with kerosene or crude petroleum at least once a week from the time warm weather sets in in the spring until cold weather comes in the fall. Those having lime and sulphur compound could use it to good advantage for destroying lice and mites in the poultry house.

Market all cockerels, except those intended for breeding purposes, as soon as they attain broiler size, for they will pay a larger profit at that time than if held until fall when the market becomes overcrowded.

It is urged that club members strictly adhere to the following rules in handling their poultry and eggs:

1. Keep the nests clean, provide one nest for every four hens.
2. Gather the eggs twice daily.
3. Keep the eggs in a cool, dry room or cellar.
4. Market the eggs at least twice a week.
5. Sell, kill, or confine all male birds as soon as the hatching season is over.

Berkshire Clubs.—This may include all breeds of hogs or the name may be changed to suit the breed. We merely suggest here that such clubs ought to be organized in every community and the price of meat reduced in this way. It would also be the means of elevating the ideals of young people as regards diversification of crops, if they be permitted to sell a few thoroughbred pigs and use the money to improve the remaining stock. The same general rules should apply to these clubs as those above, in reference to age, membership and other like things. It would be consistent for boys



STUDYING COTTON GRADING, OF WHICH OUR PRESENT FARMERS KNOW PRACTICALLY NOTHING.

to organize hog clubs, though girls should not be barred from such clubs.

General Purpose of Club Work.—A happy rivalry always stimulates us to great efforts to accomplish something, and clubs have done much to interest boys and girls in the improvement of farm crops and farm animals. It should interest them as much in the improvement of school work and school life, and school improvement clubs should be organized. Teachers should always see to it that a school improvement club is organized in their own schools. Boys and girls will do much toward keeping a school together and advancing its causes, if they once get interested. So will they aid in improving the home, if they are encouraged in home improvement and crop improvement. If they take no interest in such matters, it is because they have not been trained to do so, and therefore have been neglected. Give them some encouragement, and great results may be expected.

SOME SCORE CARDS FOR DIFFERENT CONTESTS:

SCORE CARD FOR THE COTTON PLANT.

THE COTTON PLANT.	SCORE		
	Perfect	Student's	Corrected
PLANT, VIGOROUS, STOCKY, 25 POINTS:			
SIZE, medium to large as influenced by soil, location, season and variety.....	5		
FORM, symmetrical, spreading, conical, height and spread according to soil, etc.....	5		
STALK, minimum amount of wood in proportion to fruit....	5		
BRANCHES, springing from base, strong, vigorous, in pairs, short-jointed, inclined upward.....	5		
HEAD, well branched and filled, fruited uniformly.....	5		
FRUITING, 24 POINTS:			
BOLLS, large, abundant, uniformly developed, plump, sound, firm, well-rounded, apex obtuse, singly or in clusters.....	4		
NUMBER OF BOLLS, according to variety, soil and season....	4		
BOLLS PER PLANT, thin uplands, 10-20; fertile uplands, 20-25; "bottoms," 50-100; special selections, 100-500....	4		
BOLLS PER POUND OF SEED COTTON, large, 40-60; medium, 20-75; small, 80-110.....	4		
CHARACTER OF BOLLS, number of locks 4 to 7; kind of sepals; retention of cotton.....	4		
OPENING OF BOLLS, uniform including top crop, classify as good, medium, poor.....	4		
YIELD—STANDARD ONE BALE PER ACRE, 30 POINTS:			
SEED COTTON, estimated by average plant, distance of planting, per cent. of stand, plants per acre; thin uplands, 10,000; fertile uplands, 6,500; "bottoms", 4,500; distance of plants 3½x1¼ ft., 4½x1½ ft., 4½x2 ft., respectively.....	12		
PER CENT. LINT, not less than 30, standard 40.....	12		
SEEDS, 30-50 per boll, large, plump, easily delinted, color, according to variety; germination not less than 95 per cent.....	6		
QUALITY AND CHARACTER OF LINT, 21 POINTS:			
STRENGTH, tensile strain good, even throughout length....	5		
LENGTH, long, according to local standard, upland 7-8 to 1 inch; intermediate 1¼ to 1 5-16 inches; long staple 1½ to 2 inches.....	5		
FINENESS, fibers soft, silky and pliable, responsive to touch.....	5		
UNIFORMITY, all fibers of equal length, strength, fineness.....	5		
PURITY, color dead white; fiber free from stain, dirt and trash.....	1		
Total.....	100		

No. of Plant..... Source.....
 Type.....
 Remarks on Plant.....
 Date..... 19..... Name of Student.....

DIRECTIONS FOR JUDGING COTTON.

1—THE PLANT.

On the score card the ideal plant is given a rating of 25 points. For plants departing only slightly from the variety standard as to size, a cut of 1 to 1½ points should be made. If this departure is very marked a cut of 3 points may be made.

For excessive long joints and poorly placed and developed branches cut a maximum of 2 to 5. For slight defects in these respects cut from 2½ to 3 points.

For a well-opened or vase-shaped head admitting light and air in abundance allow 5 points as the perfect score.

SCORE CARD FOR CORN.

Class.....	STANDARD.	Variety.....
Stalks per Acre.....		Ears per Stalk.....
Weight of Ears.....	Lbs.	Yield per Acre.....
		Bus.
Ear	{ Length.....inches. { Circumference.....inches.	Color { Grain..... { Cob.....

	Standard	Student's Score	Correct Score
Uniformity:			
a. Uniformity of exhibit			
b. Trueness to type	10		
Shape of ear—cylindrical.....	10		
Weight—according to standard.....	10		
Length—according to standard.....	5		
Circumference—according to standard.....	5		
Market condition and quality—sound and bright.....	20		
Color—No discolored grains.....	5		
Tips—Covered over end.....	10		
Butts—Filled out, rows straight.....	5		
Space between rows—very little.....	5		
Uniformity and shape of kernels.....	10		
Percent. of grain, estimated.....	5		
	Found.		
Total.....	100		

Name of Student.....

Date..... 19.....

UNIFORMITY.—It is important that the ears of an exhibit shall be uniform in length, circumference, color, shape of kernel and shape of ear. The exhibit should be true to type, that is, correspond closely to the accepted standard for the variety.

SHAPE OF EAR.—Other conditions equal, the cylindrical form of ears yields the highest percentage of grain to cob. Large, expanded butts and ears decidedly tapering must be discarded.

LENGTH AND CIRCUMFERENCE.—Abnormally long or large ears are objectionable. The medium, symmetrical and compact ear is preferred to the mammoth kind.

MARKET CONDITION AND QUALITY.—The grain should be sound and bright. Discolored germs should be severely discounted since corn in this condition will not germinate. Chaffy grains usually indicate immaturity or curtailed development.

HOG AND POULTRY CONTEST.

To get the boys and girls interested in live stock, we would suggest to the county school commissioners that they offer liberal prizes for a contest of this kind to be held at the same time as the Corn Contest. The chief reason for selecting these two classes of live stock is that the boys and girls can usually afford to invest the small amount of capital necessary to get a start in this line, and it is also true that the hogs and poultry will give larger returns for money invested than any other class of live stock.

SCORE CARD.

BACON HOGS.		Perfect Score	Student's Score	Corrected Score
GENERAL APPEARANCE, 36:				
WEIGHT, 170 to 200 lbs., largely the result of thick covering of firm flesh.....		6		
FORM, long, level, smooth, deep.....		10		
QUALITY, hair fine, skin thin; bone fine; firm, even covering of flesh without any soft bunches of fat or wrinkles.....		10		
CONDITION, deep, uniform covering of flesh, especially in regions of valuable cuts.....		10		
HEAD AND NECK, 6:				
SNOUT, fine.....		1		
EYES, full, mild, bright.....		1		
FACE, slim.....		1		
EARS, thin, medium size.....		1		
JOWL, light, trim.....		1		
NECK, medium length, light.....		1		
FORE SHOULDERS, 10:				
SHOULDERS, free from roughness, smooth, compact and same width as back and hind quarters.....		6		
BREAST, moderately wide, full.....		2		
LEGS, straight, short, strong; bone clean; pasterns upright, short; feet medium size.....		2		
BODY, 34:				
CHEST, deep, full girth.....		4		
BACK, medium and uniform in width, smooth, slightly arched.....		8		
SIDES, long, smooth, level from beginning of shoulders to end of hind quarters. The side at all points should touch a straight edge running from fore to hind quarter.....		10		
RIBS, deep.....		2		
BELLY, trim, firm, thick without any flabbiness or shrinkage at flank.....		10		
HIND QUARTERS, 14:				
HIPS, smooth, wide; proportionate to rest of body.....		2		
RUMP, long, even, straight, rounded toward tail.....		2		
GAMMON, firm, rounded, tapering, fleshed deep and low towards hocks.....		8		
LEGS, straight, short, strong; feet medium size; bone clean; pasterns upright.....		2		
Total.....		100		

SCORE CARD.

LARD HOGS.	Perfect Score	Student's Score	Corrected Score
GENERAL APPEARANCE, 36:			
WEIGHT, score according to age.....	6		
FORM, deep, broad, low, long, symmetrical, compact, standing squarely on legs.....	10		
QUALITY, hair silky; skin fine; bone fine; flesh smooth, mel- low, and free from lumps or wrinkles.....	10		
CONDITION, deep, even covering of flesh, especially in re- gions of valuable cuts.....	10		
HEAD AND NECK, 6:			
SNOUT, medium length, not coarse.....	1		
EYES, full, mild, bright.....	1		
FACE, short, cheeks full.....	1		
EARS, fine, medium size, soft.....	1		
JOWL, strong, neat, broad.....	1		
NECK, thick, medium length.....	1		
FORE QUARTERS, 10:			
SHOULDERS, broad, deep, full, compact on top.....	6		
BREAST, advanced, wide.....	2		
LEGS, straight, short, strong; bone clean; pasterns upright; feet medium size.....	2		
BODY, 30:			
CHEST, deep, broad, large girth.....	2		
SIDES, deep, lengthy, full; ribs close and well sprung.....	6		
BACK, broad, straight, thickly and evenly fleshed.....	10		
LOIN, wide, thick, straight.....	10		
BELLY, straight, even.....	2		
HIND QUARTERS, 18:			
HIPS, wide apart, smooth.....	2		
RUMP, long, wide, evenly fleshed, straight.....	2		
HAM, heavily fleshed, plump, full, deep wide.....	10		
THIGHS, fleshed close to hocks.....	2		
LEGS, straight, short, strong; bone clean; pasterns upright; feet medium size.....	2		
Total.....	100		

RULES.

The contestant, at the time of entering his pig at the county fair, must file with the county school commissioner the following points:

- Age of pig.....
- Breed of pig.....
- Estimated weight.....
- Kind, quantity, and cost of feeding per month.....
-
- Kind, quantity, and cost of pasture per month.....
-
- Cost of raising pig.....
- Market value of pig.....
- Profit.....

Signed.....

In awarding the premiums, the judges should consider the profit as well as score of the pig entered.

POULTRY CONTEST.

As the value of poultry and eggs in the United States exceeds the value of either corn or cotton, it is deemed desirable to inaugurate a contest in poultry raising, for boys and girls of Georgia. The exhibit should take place in connection with the exhibit of the corn and cotton.

As there are very few farms in Georgia that maintain a pure breed of any kind of fowls, it is thought best to base the contest on the exhibition of any three fowls raised by the exhibitor; a cockerel and two pullets, also individual cockerel and pullet. This insures the exhibition of fowls raised the present season.

Although it may be desirable to have only pure bred fowls exhibited, any single fowl, or trio of fowls should be admitted that possess points of merit.

The points to be considered in judging the exhibits should be based on the usefulness of the fowl from the farmer's standpoint, rather than on the fancy breeds.

The fowls should be judged on the following points: (1) As to whether they belong (a) to the distinctly egg breeds represented by the Leghorns, Minorcas, and Games; (b) to the meat breeds represented by the Langshans, Brahmas, and Cochins, or (c) to the general purpose class represented by Plymouth Rocks, Wyandottes, Indian Games, and Orpingtons.

2. As to their ability to care for themselves on the farm.

3. General appearance.

4. Maturity at the time of exhibit.

5. Weight.

6. Plumage.

A record should be filed with the exhibit covering the following points:

1. Number eggs set.

2. Date of hatching.

3. Number hatched.

4. Food used.

5. In case of mixed or cross breeds, from what breeds descended?

6. Age of fowl.

The fowls should be from a single brood, but in the event they are selected from the entire flock, the record should be filled out for each fowl.

Prizes should be given as follows:

Any Breed.

1. Best single cockerel.

2. Best single pullet.

3. Best trio.

Egg Producing Breeds.

1. Best single cockerel.

2. Best single pullet.

3. Best trio.

Meat Producing Breeds.

1. Best single cockerel.

2. Best single pullet.

3. Best trio.

All Purpose Fowls.

1. Best single cockerel.
2. Best single pullet.
3. Best trio.

In the outlining of this chapter, State College and Department of Agriculture bulletins have been freely used and quoted, and much of the material is so excellent that it might almost be said to be standardized. For such contests, our national, State, and local authorities have sought the best instruction and advice, and these authorities always welcome co-operation among all who are doing work along similar lines.

For literature on any subjects treated, write to your State College of Agriculture, or the United States Department of Agriculture, at Washington, and they will gladly send you matter on almost any desired line of thought that pertains to Agriculture.

CHAPTER XL.

THE FARMER'S OPPORTUNITY.

The Open Country.—How exhilarating it is for a farmer to be able to see a beautiful sunrise and sunset without the dimming influence of city smoke, or to be able to mingle with the beauties of the great world at his own door. How thankful he should be to see the stars, the envoys of beauty that come out in renewed glory every night undimmed by the dusty atmosphere of city streets! The influence of the open country is wholesome and has always fostered the best citizenship when accompanied with the refining influences of literature, art, and a high order of religion. There is more pure oxygen in a country home than in any other home in the world and this makes for a wholesome body. A wholesome body is worth all and should grow the best mind, other things being equal.

Health on the Farm.—As has just been said, the country is the place of good health. The one hindrance to this is the question of a lack of proper sanitation. Our farmers as a class of people do not take the proper precautions against contagious diseases, and the death rate is too high. A farmer ordinarily is careless about his well, his stables and his privies. These three necessities should be studied and cared for above everything else. The most fevers to which we are subjected and with which we die, are gotten by drinking impure water, or eaten with our food on which houseflies have been crawling, or come through

mosquitoes. Our wells should therefore be most carefully drained, so that no surface water can possibly get in them and should be cleaned at least every three months. Our stable should be cleaned out at least every month,—every week would be better—in order to prevent houseflies from breeding in them. When the stables are cleaned, the manures should have lime put with them which prevents the flies from hatching. No puddles of water should be left about the farm for mosquitoes to hatch in. Small puddles in our small brooks and branches are the source of most of the mosquito life on the farm. This can be remedied very easily if the farmer will only keep watch and not let the puddles form.

Farm Conveniences.—It may be presumed that farmers can no longer make the claim that poverty keeps them from having conveniences about the home. It is these conveniences and the demand for them, or should I not say the lack of a demand for them, that differentiates the farmer from his city neighbors. It is easy to have waterworks, a sewer system and furnace heating in every country home. Personally I would prefer a home near-by some small stream of water so the water would afford power for a small electric dynamo, so I could have electric lights. This is no far off dream nor is it impossible under such conditions to have such lights. Acetylene gas may be used both for lighting and cooking with great satisfaction. We must have on the farm well screened houses, convenient and comfortable kitchens, and everything to help lessen the work of the housekeeper.

We must have also a small cannery for putting up the winter supply of foods. We must have also gardens from which something may be gotten to eat every day in the year. There is no use in letting our gardens be called *spring gardens* any longer. We can get as much from the garden in autumn and winter as we can in spring and summer if we only try. Study from the almanac the



SUCH ROADS MAKE MARKETING EXPENSIVE.

kinds of vegetables that will stand the winter weather and then see that these are put out in the proper time to do best.

Farm Dairying.—This subject will be discussed from the standpoint of the dairy run for individual use rather than the one used as a commercial

dairy. Every farmer either has or should have a small dairy to supply his table with milk and its products. Milk is undoubtedly the best medium for the growth of all kinds of disease germs and if not carefully handled is likely to be the one article of food that spreads fever to all members of the family. It should be handled when possible in a house separated by some distance from the dwelling house, such as a spring house, and should be



GOOD ROADS SAVE TIME AND HORSE FLESH.

arranged so that it would stay cool in summer and not allowed to freeze in winter. A home dairy should also be sterilized very often, and the milk vessels scalded at least once a day. It is easier to do this than it is to have to surrender life on account of not doing it.

The Farmer as a Citizen.—It may be said with safety that very few classes of citizens are students

of government and the needs of a people. There are some classes that make a better study of the question of government than farmers, but no one has a better opportunity to become an ideal citizen than the farmer. To do this he must not be deceived into all kinds of prejudices. He must know the truth about government and then study the needed changes. To know the truth all of us must study papers and books. We must know all our national officers, their duties and their salaries. We must know the term of office of all government officials and State officials, as well as the method of election. Name those who are elected by the people and those who are not. As to those who are not, we must learn how they are elected. These are subjects that will be learned in our histories and civics, but are worth enumerating here. The information suggested above should be posted in every school room in the United States, and pupils of the higher grades should be required with the help of the teacher to collect and post such information. When the farmer knows these things, he will be a better citizen and can vote far more intelligently and feel that he is getting to exercise his privileges as a citizen to the best advantage.

Flower Yards and Lawns.—The farmer must in future give more attention to beautifying his home. This will prove to be one of the most pleasant things about the home. To see the yard gradually grow from a clean-swept barren spot into a beautiful grass covered lawn bedecked here and yonder with shrubbery and flowers is indeed a

pleasure, and will be the subject of conversation among our neighbors. The average country home is not a place of beauty, but can easily be made so, if we will spend our rest days for one year in a careful development of our farm environment. These things not only make the home more



OUR COUNTRY HOMES MIGHT BE AS TASTEFUL AS THIS ONE.

beautiful, but in fact make us and all who come in contact with these improvements more beautiful. It is therefore the best method of developing culture among our young people on the farm.

GENERAL REFERENCES.

- Bailey: "PRINCIPLES OF AGRICULTURE"—*Macmillan & Co.*
 "PRACTICAL FARMING AND GARDENING"—*Rand McNally & Co.*
 "TEN ACRES ENOUGH"—*The Cultivator Publishing Co.*
 Newman: "THE SOUTHERN GARDENER'S PRACTICAL MANUAL"—*C. L. Newman.*
 King: "THE SOIL"—*Macmillan & Co.*
 Roberts: "THE FERTILITY OF THE LAND"—*Macmillan & Co.*
 U. S. Farmers' Bulletin No. 257: "SOIL FERTILITY."
 U. S. Farmers' Bulletin No. 245: "THE RENOVATION OF WORNOUT SOILS."
 Johnson: "HOW CROPS FEED"—*Orange Judd Co.*
 Bailey: "THE HORTICULTURIST'S RULE BOOK"—*Macmillan & Co.*
 Voorhees: "FERTILIZERS"—*Macmillan & Co.*
 Harris: "TALKS ON MANURE"—*Orange Judd Co.*
 U. S. Farmers' Bulletin No. 192: "BARNYARD MANURE."
 U. S. Farmers' Bulletin No. 22: "THE FEEDING OF FARM ANIMALS."
 "DAVID DICKSON'S SYSTEM OF FARMING"—*Cultivator Publishing Co.*
 U. S. Farmers' Bulletin No. 151: "DAIRYING IN THE SOUTH."
 U. S. Farmers' Bulletin No. 41: "FOWLS, CARE AND FEEDING."
 U. S. Farmers' Bulletin No. 129: "SWEET POTATOES."
 U. S. Farmers' Bulletin No. 62: "MARKETING FARM PRODUCE."
 U. S. Farmers' Bulletin No. 95: "GOOD ROADS FOR FARMERS."
 U. S. Farmers' Bulletin No. 218: "THE SCHOOL GARDEN."
 U. S. Farmers' Bulletin No. 154: "THE HOME FRUIT GARDEN."
 U. S. Farmers' Bulletin No. 156: "THE HOME VINEYARD."
 U. S. Farmers' Bulletin No. 242: "AN EXAMPLE OF MODEL FARMING."

Farmers' bulletins are sent free upon application to the Secretary of Agriculture or to Congressmen. Many of them are very valuable and pupils should learn to consult them. The teacher should also make use of the bulletins of the State experiment station which can be had upon request.

ADDRESSES OF SOUTHERN AGRICULTURAL EXPERIMENT STATIONS WITH NAMES OF DIRECTORS, FROM WHOM FREE BULLETINS MAY BE SECURED.

- Alabama—Auburn; J. F. Duggar.
 Arkansas—Fayetteville; C. F. Adams.
 Florida—Gainesville; P. H. Rolfs.
 Georgia—Experiment; R. J. H. DeLoach.
 Kentucky—Lexington; J. H. Kastle.
 Louisiana—Baton Rouge; W. R. Dodson.
 Mississippi—Agricultural College; E. R. Lloyd.
 North Carolina—Raleigh; B. W. Kilgore.
 Oklahoma—Stillwater; J. A. Wilson.
 South Carolina—Clemson College; J. N. Harper.
 Tennessee—Knoxville; H. A. Morgan.
 Texas—College Station; B. Youngblood.
 Virginia—Blacksburg; S. W. Fletcher.

USEFUL TABLES.

We add a number of tables, compiled from various sources. They contain much useful information, and should be memorized by the student or farmer.

COMPOSITION OF MANURES.

TABLE I.
Nitrogenous Manures.

ARTICLE	POUNDS PER HUNDRED.		
	Nitrogen	Phosphoric Acid	Potash
Sodium nitrate.....	15½ to 16		
Ammonium sulphate.....	19 to 20½		
Dried blood, high-grade.....	12 to 14		
Dried blood, low-grade.....	10 to 11	3 to 5	
Concentrated tankage.....	11 to 12½	1 to 2	
Tankage, bone.....	5 to 6	11 to 14	
Dried fish scrap.....	7 to 9	6 to 8	
Cotton-seed meal.....	6½ to 7½	1½ to 2	2 to 3

TABLE II.
Phosphatic Manures.

ARTICLE	POUNDS PER HUNDRED.			
	Phosphoric Acid			Nitrogen
	Available	Insoluble	Total	
S. C. phosphate rock.....		26 to 28	26 to 28	
Florida phosphate rock.....		33 to 35	33 to 35	
S. C. dissolved rock.....	12 to 15	1 to 3	13 to 16	
Florida dissolved rock.....	14 to 16	1 to 4	16 to 20	
Ground bone.....	5 to 8	15 to 17	20 to 25	2½ to 4½
Steamed bone.....	6 to 9	16 to 20	22 to 29	1½ to 2½
Dissolved bone.....	13 to 15	2 to 3	15 to 17	2 to 3

COMPOSITION OF MANURES—Continued.

TABLE III.
Potassic Manures.

ARTICLE	POUNDS PER HUNDRED			
	Potash	Phosphoric Acid	Lime	Chlorine
Muriate of potash.....	50	.....	.....	45 to 48
Sulphate of potash.....	48 to 52	.....	.....	½ to 1½
Kainit.....	12 to 12½	.....	.....	30 to 32
Sylvanit.....	16 to 20	.....	.....	42 to 46
Cotton-seed hull ashes.....	20 to 30	7 to 9	10	.....
Wood ashes, unleached.....	2 to 8	1 to 2	30 to 35	.....
Wood ashes, leached.....	1 to 2	1 to 1½	35 to 40	.....
Tobacco stems.....	5 to 8	3 to 5	3½	.....

TABLE IV.
Average Composition of Farm Manures.

ARTICLE	POUNDS PER HUNDRED				
	Moisture	Nitrogen	Phosphoric Acid	Potash	Lime
Cow manure, fresh.....	85.3	0.38	0.16	0.36	0.31
Horse manure.....	71.3	0.53	0.28	0.53	0.21
Sheep manure.....	64.6	0.83	0.23	0.67	0.33
Hog manure.....	72.4	0.45	0.19	0.60	0.08
Hen dung.....	56.0	1.63	0.54	0.85	0.24
Mixed stable manure.....	75.0	0.50	0.26	0.63	0.70

FERTILIZER FORMULAS.

TABLE V.

Simply as guides the following are recommended for ordinary soil in fair condition:

For Cotton:

Cottonseed meal.....	300 lbs.
Acid phosphate.....	1,400 lbs.
Kainit.....	300 lbs.
Use from 200 up to 800 pounds per acre.	

For Corn:

Cottonseed meal.....	200 lbs.
Acid phosphate.....	1,600 lbs.
Kainit.....	200 lbs.
Use 200 up to 1,000 pounds per acre.	

For Potatoes, Melons, etc.:

Cottonseed meal.....	600 lbs.
Acid phosphate.....	1,000 lbs.
Kainit.....	400 lbs.
Use 600 to 2,000 pounds per acre.	

For Small Grains and Grasses:

Cottonseed meal.....	800 lbs.
Acid phosphate.....	1,000 lbs.
Kainit.....	200 lbs.
Use 200 to 600 pounds per acre.	

The materials needed to make a ton of compost according to a good formula are as follows:

Quick lime.....	100 lbs.
Kainit.....	150 lbs.
Acid phosphate (14 per cent.).....	250 lbs.
Cottonseed meal.....	200 lbs.
Stable manure.....	1,200 lbs.

or

Quick lime.....	100 lbs.
Kainit.....	150 lbs.
Acid phosphate (14 per cent.).....	250 lbs.
Green cottonseed.....	400 lbs.
Stable manure.....	1,000 lbs.

PLANT FOOD REMOVED BY CROPS.

TABLE VI.

	Nitrogen	Phos. Acid	Potash
<i>One 500 pound bale of cotton removes:</i>			
Lint.....	1.22	.30	3.82
Seed.....	27.13	9.00	9.25
Total.....	28.35	9.30	13.07
<i>Fifty bushels of corn removes:</i>			
Grain.....	54.06	21	12
Stover.....	41.06	11.06	56
Total.....	95.12	32.06	68
<i>Fifteen bushels of wheat removes:</i>			
Grain.....	20.25	7.85	5.6
Straw.....	14.00	3.00	12.5
Total.....	34.25	10.85	18.1
<i>Thirty bushels of oats removes:</i>			
Grain.....	19.2	8.0	6.2
Straw.....	15.3	5.2	30.3
Total.....	34.5	13.2	36.5

SAVING MANURE.

The South loses thousands of dollars annually from the effect of burning stalks and stubble upon our lands. 2,000 pounds of corn or cotton stalks make only fifty pounds of ashes, worth \$10.00 per ton. As a decayed vegetable matter they would be worth at least \$5.00.

Stable manure left exposed to the weather four months, worth per ton at beginning \$2.80, loss per ton \$1.74, loss per cent. 62.

PLANTING TABLES.

TABLE VII.

Amount of seed necessary to plant an acre (Henderson's "Gardening for Profit").

Asparagus.....		4 to 5 pounds.
Bean, dwarf	in drills.....	2 bushels.
Bean, pole	in hills.....	10 to 12 quarts.
Beet.....	in drills.....	5 to 6 pounds.
Cabbage.....	in beds, to transplant.....	$\frac{1}{2}$ pound.
Carrot.....	in drills.....	3 to 4 pounds.
Corn.....	in hills.....	8 to 10 quarts.
Corn (for soiling).....		3 bushels.
Cucumber.....	in hills.....	2 to 3 pounds.
Cress, water.....	in drills.....	2 to 3 pounds.
Cress, upland.....	in drills.....	2 to 3 pounds.
Kale, or sprouts.....		3 to 4 pounds.
Mustard.....	broadcast.....	3 to 4 pounds.
Melon (musk).....	in hills.....	2 to 3 pounds.
Melon (water).....	in hills.....	4 to 5 pounds.
Onion (for sets).....	in drills.....	30 pounds.
Onion.....	in drills.....	5 to 6 pounds.
Onion (sets).....	in drills.....	6 to 12 bushels.
Parsnip.....	in drills.....	4 to 6 pounds.
Pea.....	in drills.....	2 bushels.
Pea.....	broadcast.....	3 bushels.
Potato (cut tubers).....		10 to 12 bushels.
Pumpkin.....	in hills.....	4 to 6 pounds.
Radish.....	in drills.....	8 to 10 pounds.
Sage.....	in drills.....	8 to 10 pounds.
Salsify.....	in drills.....	8 to 10 pounds.
Spinach.....	in drills.....	10 to 12 pounds.
Squash (running varieties).....	in hills.....	3 to 4 pounds.
Squash (bush varieties).....	in hills.....	4 to 6 pounds.
Tomato.....	to transplant.....	$\frac{1}{4}$ pound.
Turnip.....	in drills.....	1 to 2 pounds
Turnip.....	broadcast.....	3 to 4 pounds.
Barley.....	broadcast.....	2 to 3 bushels.
Broom corn.....	in hills.....	8 to 10 quarts.
Clover (red), alone.....		15 to 20 pounds
Clover (white), alone.....		12 to 15 pounds.
Clover (Alsike), alone.....		8 to 10 pounds.
Clover (Lucern), alone.....		20 pounds.
Grass (mixed lawn).....		4 to 5 bushels.
Oats.....	broadcast.....	2 to 3 bushels.
Rye.....	broadcast.....	$1\frac{1}{2}$ to 2 bushels.
Vetches.....	broadcast.....	2 to 3 bushels.
Wheat.....	broadcast.....	$1\frac{1}{2}$ to 2 bushels.
Timothy, alone.....		$\frac{1}{2}$ bushel.
Orchard grass, mixture.....		4 to 5 bushels.
Millet.....		$\frac{1}{2}$ to 1 bushel.

PLANTING TABLES—Continued.

TABLE VIII.

Number of Plants per Acre at Different Distances.

DISTANCES.	PLANTS.	DISTANCES.	PLANTS.
2 feet x 2 feet.....	10,890	8 feet x 8 feet.....	680
2 feet x 3 feet.....	7,260	8 feet x 10 feet.....	544
2 feet x 4 feet.....	5,445	10 feet x 10 feet.....	435
2 feet x 5 feet.....	4,356	10 feet x 12 feet.....	363
2 feet x 6 feet.....	3,630	10 feet x 15 feet.....	290
3 feet x 3 feet.....	4,840	10 feet x 18 feet.....	242
3 feet x 4 feet.....	3,630	10 feet x 20 feet.....	217
3 feet x 5 feet.....	2,904	20 feet x 20 feet.....	108
3 feet x 6 feet.....	2,420	20 feet x 30 feet.....	72
4 feet x 4 feet.....	2,722	30 feet x 30 feet.....	48
4 feet x 5 feet.....	2,178	30 feet x 36 feet.....	40
4 feet x 6 feet.....	1,185	40 feet x 40 feet.....	27
5 feet x 5 feet.....	1,742	40 feet x 50 feet.....	21
5 feet x 6 feet.....	1,452	40 feet x 60 feet.....	18
6 feet x 6 feet.....	1,210	50 feet x 50 feet.....	17
6 feet x 8 feet.....	907		

LEGAL OR CUSTOMARY WEIGHTS OF BUSHEL
OF PRODUCE.

TABLE IX.

ARTICLES.	POUNDS.	ARTICLES.	POUNDS.
Apples.....	48	Peas.....	60
Apples, dried.....	26	Bluegrass seed.....	14
Beans, castor.....	60	Turnips.....	55
Beans, white.....	60	Wheat.....	60
Buckwheat.....	56	Peanuts.....	28
Corn, ear.....	70	Cottonseed.....	32
Corn, shelled.....	56	Barley.....	48
Corn meal.....	50	Rye.....	56
Onions.....	57	Rutabagas.....	60
Peaches.....	38	Oats.....	32
Potatoes, Irish.....	60	Clover seed.....	60
Potatoes, sweet.....	50		

STOCK FOODS.

TABLE X.

Pounds of Fertilizing Constituents Per Ton			Note—Protein is the food that forms muscle, milk, etc. Carbohydrates and fat form the fat of the animal and give heat and energy.	Digestible Nutrients in ONE POUND Expressed in Decimals				Nutritive Ratio
Potash	Phosphoric Acid	Nitrogen		Total Dry Matter	Digestible Protein	Digestible Carbohydrates	Digestible Fat	
			NAMES OF FEEDS					
			Green Fodders.					
6	3	6	Corn fodder.....	.207	.011	.121	.004	1:11.9
5	1.8	6	Sorghum fodder.....	.206	.007	.176	.012	1:29
14	5	10.6	Rye fodder.....	.234	.021	.141	.004	1:7.1
			Kentucky Blue Grass.....	.349	.030	.198	.008	1:7.2
8	3	10.8	Red clover.....	.292	.029	.148	.007	1:5.6
			Crimson clover.....	.193	.022	.093	.004	1:4.6
6	2	5.4	Cowpea vines.....	.164	.018	.087	.002	1:5
11.2	2.6	14.4	Alfalfa.....	.282	.039	.112	.004	1:3.1
10.6	3	5.8	Soy bean.....	.285	.028	.118	.006	1:4.8
7.2	3	9	Rape.....	.140	.015	.081	.002	1:5.7
			Hungarian grass (German millet).....	.289	.020	.169	.004	1:8.4
			Oat fodder.....	.378	.026	.187	.010	1:8.2
			Bermuda grass.....	.283	.014	.171	.006	1:13.2
			Crab grass.....	.235	.038	.099	.007	1:3
			Ensilage.					
7.4	2	5.2	Corn silage.....	.209	.009	.113	.007	1:14.3
			Sorghum silage.....	.239	.006	.149	.002	1:25.6
			Cowpea silage.....	.207	.015	.084	.009	1:7
			Soy bean silage.....	.258	.027	.084	.013	1:4.3
9.2	2.6	10.6	Clover silage.....	.280	.020	.132	.010	1:7.9
			Alfalfa silage.....	.275	.030	.181	.019	1:4.3
			Hay and Dry Fodders.					
28	5.8	20.2	Corn stover.....	.595	.017	.324	.007	1:20
17.8	10.8	35.2	Corn fodder.....	.578	.025	.343	.012	1:14.9
31	5.4	28	Hay of mixed grasses.....	.871	.059	.409	.012	1:7.4
44	7.6	40	Red clover.....	.847	.076	.384	.020	1:5.7
29.4	10.4	53.2	Cowpea vine hay.....	.893	.108	.390	.011	1:3.8
33.6	10.2	43.8	Alfalfa hay.....	.916	.110	.393	.012	1:3.8
21.6	13.4	46.4	Soy bean hay.....	.887	.108	.385	.015	1:3.9
			Vetch hay.....	.887	.129	.329	.031	1:3.1
35.4	5.6	9.2	Oat straw.....	.908	.012	.386	.008	1:33.6
			Mixed vetch and oat hay.....	.869	.078	.388	.004	1:5
			Oat hay.....	.911	.043	.460	.015	1:11.6
19.6	5.8	35.2	Peanut hay.....	.924	.068	.417	.030	1:7.2
			Wheat straw.....	.904	.004	.363	.004	1:93
18	10.6	25.2	Timothy hay.....	.868	.028	.431	.014	1:16.6

STOCK FOODS—Continued.

Pounds of Fertilizing Constituents Per Ton			Note—Protein is the food that forms muscle, milk, etc. Carbohydrates and fat form the fat of the animal and give heat and energy.	Digestible Nutrients in ONE POUND Expressed in Decimals				Nutritive Ratio
Potash	Phosphoric Acid	Nitrogen		Total Dry Matter	Digestible Protein	Digestible Carbohydrates	Digestible Fat	
			NAMES OF FEEDS					
			Root Crops, Etc.					
6.8	1.8	3.8	Turnips.....	.095	.010	.061	.002	1:7.7
7.6	1.8	3.8	Mangel beets.....	.091	.011	.054	.001	1:5.1
5.6	2	4.4	Sugar beets.....	.135	.011	.102	.001	1:9.4
10.2	1.8	3	Carrots.....	.114	.008	.078	.002	1:10.3
9.2	2.4	6.4	Irish potatoes.....	.316	.012	.241	.....	1:20
8.6	2.2	7.6	Cabbages.....	.153	.018	.031	.004	1:5.1
9.4	2.8	5.2	Artichokes.....	.200	.020	.168	.002	1:8.7
....	....	....	Pumpkins.....	.091	.010	.058	.003	1:6.5
			Grain and Other Seeds.					
7.4	11.4	31.6	Corn.....	.891	.080	.659	.046	1:9.6
9.6	13.8	33	Oats.....	.890	.092	.473	.042	1:6.2
9.6	15.8	30.2	Barley.....	.891	.087	.656	.016	1:8
10	15.8	47.2	Wheat.....	.895	.102	.688	.017	1:7.2
10.8	16.4	35.2	Rye.....	.884	.099	.673	.011	1:7.1
19.8	16.4	77.4	Cowpeas.....	.878	.200	.532	.008	1:2.8
....	....	....	Kaffir corn.....	.875	.058	.536	.013	1:9.8
			Mill Products.					
8	12.6	31.6	Corn meal.....	.850	.063	.653	.035	1:11.7
9.4	11.4	28.2	Corn and cob meal.....	.849	.044	.600	.029	1:15.1
7	11.2	57.8	Low grade flour.....	.876	.082	.627	.009	1:7.9
....	....	....	Ground corn and oats (equal parts)	.881	.070	.612	.139	1:8.7
19.8	16.4	61.6	Pea meal.....	.895	.168	.515	.007	1:3
....	....	....	Oat meal.....	.921	.115	.510	.059	1:5.7
			By-Products.					
32.2	57.8	53.4	Wheat bran.....	.881	.122	.392	.027	1:3.7
11.8	27	56.4	Wheat shorts.....	.882	.122	.459	.038	1:4.8
30	60	130.	Cottonseed meal.....	.915	.381	.160	.126	1:1.2
20.4	5	13.8	Cottonseed hulls.....	.895	.003	.329	.017	1:125
3.8	4	11.2	Skim milk.....	.096	.031	.045	.008	1:2.1
3.2	3.4	9.6	Butter milk.....	.099	.039	.038	.011	1:1.7
3.6	2.8	3	Whey.....	.066	.008	.047	.003	1:6.8
3.6	3.8	10.6	Whole milk.....	.128	.036	.040	.037	1:3.6

STOCK FOODS—Continued.

TABLE XI.

Pounds of Food Required Per Day for 1,000 Pounds Live Weight.

KIND OF ANIMAL	Total Dry Matter	DIGESTIBLE NUTRIENTS			Nutritive Ratio
		Protein	Fat	Carbo- hydrates	
Oxen at rest in stall.....	18	0.7	0.1	8.0	1:11.8
Oxen at moderate work.....	25	2.0	0.5	11.5	1: 6.5
Fattening cattle.....	28	2.7	0.6	15.0	1: 6.1
<i>Milch cows:</i>					
Giving 1½ gallons milk.....	25	1.6	0.3	10.0	1: 6.7
Giving 2 gallons milk.....	27	2.0	0.4	11.0	1: 6.0
Giving 2½ gallons milk.....	28	2.5	0.5	12.0	1: 5.3
Giving 3 gallons milk.....	32	3.3	0.8	13.0	1: 4.5
Sheep, wool-growing.....	20	1.5	0.3	11.0	1: 7.8
Sheep, fattening.....	29	3.0	0.6	15.0	1: 5.5
Horses, moderate work.....	22	1.8	0.6	11.0	1: 6.9
Horses, hard work.....	26	2.5	0.8	13.3	1: 6.0
Swine, fattening.....	32	4.0	0.5	24.0	1: 6.3
Swine, brood sows.....	22	2.5	0.4	15.4	1: 6.6
<i>Growing Cattle:</i>					
Age in months.....					
2-3.....	150	4.0	2.0	13.8	1: 4.7
3-6.....	300	3.0	1.0	13.5	1: 5.3
6-12.....	500	2.5	0.6	13.5	1: 6.0
12-18.....	700	2.0	0.4	13.0	1: 7.0
18-24.....	850	1.5	0.3	12.0	1: 8.5

HOW TO BALANCE A RATION.

Calculate the total dry matter, protein, carbohydrates and fat in the feeds you desire to use, multiplying the figures in Table VIII by the number of pounds of the feed your experience and the inspection of its nutritive ratio suggest as a proper amount. Add the amounts of each nutrient and compare with the standard ration given in Table IX.

For example, if a cow gives about $2\frac{1}{2}$ gallons of milk and it is proposed to feed on cottonseed meal, wheat bran, cottonseed hulls and mixed hay, we might proceed as follows:

	Total Dry Matter	Protein	Carbo hydrates	Fat
3 pounds cottonseed meal.....	2.745	1.143	0.480	0.384
8 pounds wheat bran.....	7.048	0.976	3.132	0.216
20 pounds cottonseed hulls.....	17.900	0.060	6.580	0.340
5 pounds hay.....	4.355	0.295	2.045	0.060
Total nutrients.....	33.048	2.474	12.237	1.00
Standard ration.....	28.0	2.5	12.0	0.5

This ration is therefore excessive in total dry matter, carbohydrates and fat, while the protein is slightly below the standard. It can be remedied by using four pounds cottonseed meal, six pounds bran and three pounds hay.

STOCK FOODS—Continued.

TABLE XII.

Specimen Balanced Rations for Cow Giving 2½ Gallons Milk Per Day.

No. 1.

25 pounds hay.
3 pounds cottonseed meal.
2½ pounds wheat bran.
1½ pounds corn meal.
(2 pounds corn and cob meal can be substituted for corn meal.)

No. 2.

Cottonseed meal.....	4 pounds.
Corn ensilage.....	40 pounds.
Pea hay.....	15 pounds.

No. 3.

Cottonseed meal.....	4 pounds.
Wheat bran.....	6 pounds.
Corn stover.....	30 pounds.

No. 4.

Cottonseed meal.....	4 pounds.
Wheat bran.....	6 pounds.
Cottonseed hulls.....	20 pounds.
Mixed hay.....	3 pounds.

No. 5.

Wheat bran.....	6 pounds.
Cottonseed, whole.....	6 pounds.
Mixed clover and grass, or pea and sorghum hay.....	20 pounds.

Farmers' Bulletin 22, which can be procured from the Secretary of Agriculture, Washington, D. C., or by request addressed to your Congressman, contains full feeding tables and directions for calculating rations. Every farmer should get it.

WEIGHTS AND MEASURES.

TABLE XIII.

Troy Weight.

(Used by Jewelers.)

4 grains.....	1 pennyweight.
20 pennyweights.....	1 ounce.
12 ounces.....	1 pound.

Apothecaries' Weight.

(Used in weighing medicines.)

20 grains.....	1 scruple.
3 scruples.....	1 drachm.
8 drachms.....	1 ounce.
12 ounces.....	1 pound.

Avoirdupois Weight.

(Used in ordinary commercial transactions.)

27.34 grains.....	1 drachm.
16 drachms.....	1 ounce.
16 ounces.....	1 pound.
2,000 pounds.....	1 ton.

Long Measure.

12 inches.....	1 foot.
3 feet.....	1 yard.
5½ yards.....	1 rod, pole or perch.
40 rods.....	1 furlong.
8 furlongs.....	1 statute or land mile.
3 miles.....	1 league.

Square or Land Measure.

144 square inches.....	1 square foot.
9 square feet.....	1 square yard.
30½ square yards.....	1 square rod.
40 square rods.....	1 rood.
4 roods.....	1 acre.
640 acres.....	1 square mile.

Liquid Measure.

4 gills.....	1 pint—28.875 cubic inches.
2 pints.....	1 quart—57.75 cubic inches.
4 quarts.....	1 gallon—231 cubic inches.
63 gallons.....	1 hogshead.
2 hogsheads.....	1 pipe or butt.
2 pipes.....	1 tun.

Dry Measure.

2 pints.....	1 quart.
4 quarts.....	1 gallon.
2 gallons.....	1 peck.
4 pecks.....	1 struck bushel.

WEIGHTS AND MEASURES—Continued.

TABLE XIV.

The Metric System of Weights and Measures.

Metric Units in English Equivalents:

	Inches.	Feet.	Yards.	Miles.
Centimeter.....	0.393685	0.032807	.....	.....
Decimeter.....	3.93685	0.328071	0.109357	.....
Meter.....	39.3685	3.28071	1.09357	.....
Decameter.....	393.685	32.8071	10.9357	.....
Hectometer.....	.....	328.071	109.357	0.0621347
Kilometer.....	.....	3280.71	1093.57	0.6213466
Myriameter.....	.....	32807.1	10935.7	6.213466

Are—154,988 sq. in., 1,076.4 sq. ft., 119.60 sq. yds., 0.0247 acres.

Hectare—107,640 sq. ft., 11,960 sq. yds., 2.471 acres.

Liter—33.8 fluid ounces, 1.0567 liquid quarts, 0.02838 bushels.

Gram—15.43234 grains, 0.03527 ounces avoird., 0.0022 lbs. avoird.

Kilogram—2.2 lbs. avoird.

Foot—0.3048 meters, 3.048 decimeters, 30.48 centimeters.

Mile—1,609.344 meters, 1.609344 kilometers.

Acre—40.4685 ares, 0.4047 hectares.

Gallon—3.7854 liters.

Pound—0.4536 kilograms, 4.536 hectograms.

Ton (2,000 lbs.)—907.1 kilograms, 0.9071 tonneau.

Bushels—35.237 liters.

TABLE XV.

A Cubic Foot is Equal to

1728 cubic inches.

0.8036 struck bushels of 2150.42 cubic inches.

3.2143 pecks.

7.4805 liquid gallons of 231 cubic inches.

6.4285 dry gallons.

29.922 liquid quarts.

25.714 dry quarts.

59.844 liquid pints.

51.428 dry pints.

0.2667 barrel of three struck bushels.

0.2375 liquid barrel of 31½ gallons.

WEIGHTS AND MEASURES—Continued.

TABLE XVI.

A Few Interesting Facts.

One bushel of wheat contains about 320,000 grains.

One bushel of oats contains about 540,000 grains.

One bushel of cottonseed contains about 125,000 seeds.

Wheat roots will grow in good ground from six to eight feet deep.

Corn roots will grow in good ground from eight to ten feet deep.

Clover roots will grow in good ground from ten to twelve feet deep.

Alfalfa roots will grow in good ground from twelve to eighteen feet deep.

Oats will grow in good ground from eight to ten feet deep.

Common grass will grow in good ground three to four feet deep.

The following yields per acre have been made, and can be made again:

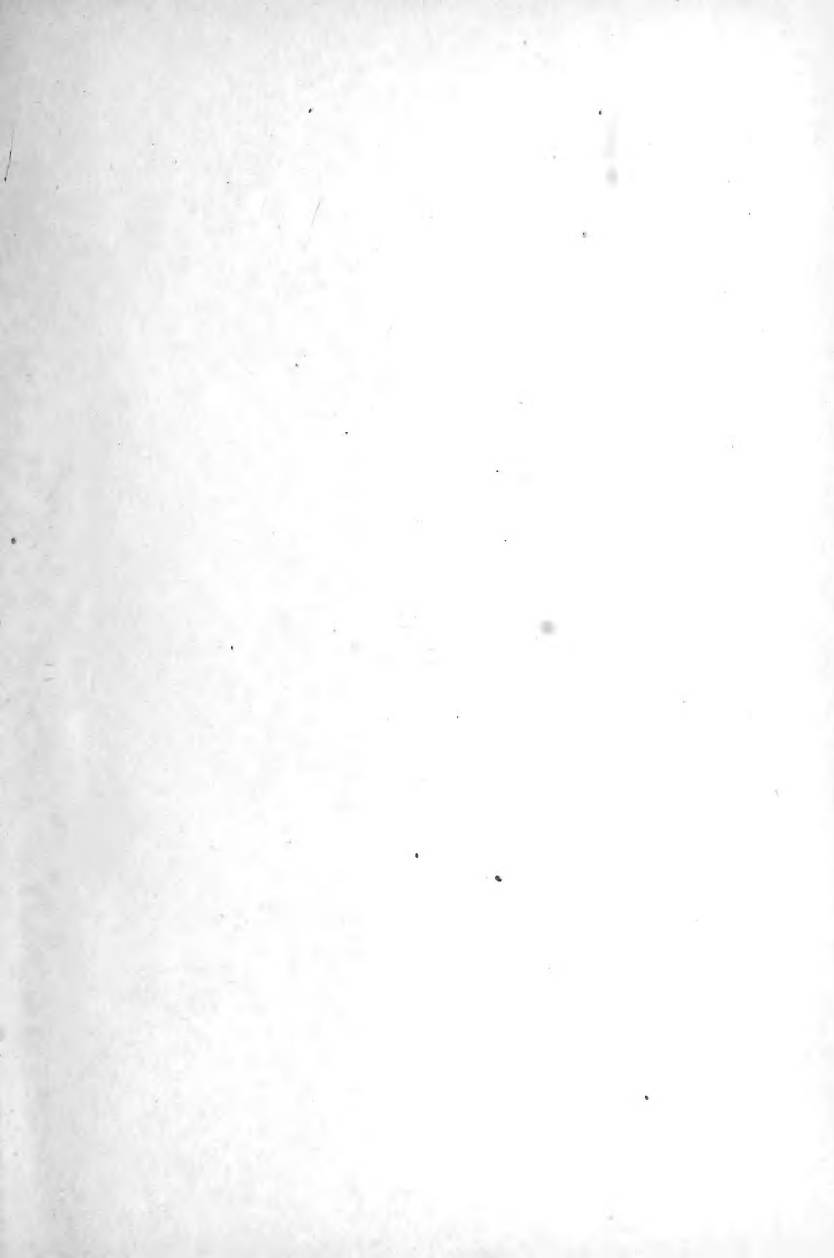
Corn.....	255 bushels.
Wheat.....	80 bushels.
Oats.....	125 bushels.
Barley.....	80 bushels.
Buckwheat.....	75 bushels.
Potatoes.....	1329 bushels.
Turnips.....	1200 to 1500 bushels.
Mangels.....	80 tons.
Timothy.....	6 tons at a cutting.
Bermuda grass.....	6 tons at a cutting.
Red clover.....	5½ tons at a cutting.

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